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Forthcoming Events.

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University College (University of London).—"The Manufacture of Nitrates from Air by Electric Power," by E. Kilburn Scott, M.I.E.E., A.M.I.C.E.—Free public lecture.

JUNE 24.

British Foundrymen's Association.—Annual General Meeting, at Connaught Rooms, Great Queen Street, London, W.C.

NOTES AND COMMENTS.

Through German Spectacles.

"O, wad some power the giftie gie us," etc.—It is not often that we have the opportunity of really seeing ourselves as others see us, for common courtesy usually masks the appraising eye and checks the candid tongue. But under war conditions those artificial restrictions do not exist and we are thus favoured by a candid expression of opinion respecting our virtues and vices from Herr Daelen, of Düsseldorf. Little as is the respect in which we hold the German spectacles—for the distorted conceptions they have produced cannot call for respect—it will be at least amusing, perhaps instructive, to take a glance at ourselves through them. At a recent technical meeting in Düsseldorf, Herr Daelen discussed the English iron and steel industry from the German point of view, and amongst other things stated that the old and unfavourable conditions of leasing in England had caused the collapse of many works which now existed as ruins. The conservatism of the banks rendered it difficult to raise capital, as the banks preferred more liquid sources of income. The ironworks which were not situated on the water had many difficulties to overcome in the matter of transport, as the railways were in different hands, and it often happened that a works had to maintain various connections, whilst they had to provide their own wagons, the capacity of which was only 8 to 10 tons. Thus the external conditions for the industry were not favourable. To these had to be added the weaknesses of the internal works organisation. The managers and officials were insufficiently educated; the directors interfered everywhere with the duties of the managers, and no clear dividing line existed between the duties and obligations of the management and the directors. The works managers were lacking in technical as well as in general preparatory education, and they were, in so far as the latter point was concerned, mostly foremen whose natural gift was their best property.

The fact that there is an element of truth in some of these contentions might lead one to credit the German vision with considerable acuteness of perception, were it not for the fact that we are largely conscious of the defects and are steadily remedying them, though not necessarily with goose-step rhythm and regularity. But Herr Daelen has not yet done with us, for he continues with the remark that the technical high schools in England are not equivalent scientifically to the German high schools, as they are rather intermediate schools. Technically the English methods of working can not, he considers, be compared with the German, being backward in all branches. These remarks almost suggest that he has been reading some of our own criticisms of our schooling systems; for the defects in British methods have been very forcibly pointed out during the last few years. It is obvious, however, that he is witness to the defects rather than to the accomplishments of our race, which was probably necessary in a Paper read at Düsseldorf,

for an impartial comparison of attainments does not always show very creditably for the German scientist.

Next our candid critic solaced his hearers with the information that the use of the waste gases of the blast furnace was not carried out in the same degree as in Germany, the open-hearth steel works did not generally use the pig-iron-ore process, but worked chiefly with scrap, and the rolling mills frequently had antiquated plant. But the worst of all was to be found in the labour conditions. Work commenced on Monday at 6 a.m., and ended on Saturday at 1 p.m.; there were three shifts of eight hours, or sixteen shifts, and 128 working hours per week as contrasted with 144 hours in Germany. The sporting proclivities of the workmen rendered it impossible to retain them at the works after 12 noon on Saturdays. A further great disadvantage lay in the powerful position of the trade unions. Standard rates of wages were in operation for all works, and piecework as in Germany could only be introduced to a limited extent. A normal standard of production was also adopted, and it was unprofitable to substitute machinery for manual labour because the workmen demanded the savings thereby effected. The fact that notwithstanding these unfavourable conditions the English iron and steel industry was still vital, was due to the satisfactory quantity and quality of coal and the ready availability of iron ore and scrap.

In the light of all this striking information we are not surprised at the annoyance and irritation which Germany feels at so much resistance and pressure from such a decadent race. At the same time, it is just possible that the German spectacles do not discern virtues when they come within the field of vision.

Smoke, Steam and Dust in Foundries.

As every foundryman knows too well, it is easier to formulate a code of restrictions prohibiting excessive fumes, steam and dust in the foundry than it is to arrange for their removal. One of the weak features of the Regulations governing brass-casting shops in this country is the fact that no particular system or class of apparatus is even recommended for the removal of the brass-casting fumes. The method of dealing with the question in many foundries seems to be somewhat on the following lines:—Instal some appliance for removing the fumes (efficacy is not a prime essential), claim for it absolutely satisfactory operation, and take care there is no excess of fumes in the shop when the inspector calls. The latter will then not experience any mental perturbation and everybody (except, of course, the moulders and casters) will be pleased.

In this connection it is interesting to recall the regulations for safety and sanitation in foundries recently approved by the State Industrial Board of Pennsylvania (U.S.A.). They relate to iron and steel foundries and came into force late last year. On the question of smoke, steam and dust the regulations in question provide that:—"Where smoke, steam, gas or dust arising from any of the operations of the foundry is dangerous to health or eyes and where a natural circulation of air does not carry it off there shall be installed and operated hoods, ventilators, fans or other mechanical means of ventilation approved by the Industrial Board. The cleaning and chipping of castings shall be done in cleaning rooms except that where travelling cranes, or where, in existing installations, cars are used for conveying castings into such rooms, a separating partition shall be erected which shall not be less than 12 ft. in height. In existing installations, where the crane cage or crane girders will not permit the erection of a 12-ft. partition, the height of the partition may be reduced sufficiently to permit of its clearance. Large castings may be chipped or cleaned by hand in the moulding and casting room, provided sufficient protection is furnished by the use of a curtain or screen or some other means equally good to protect employés who are otherwise employed therein. This regulation shall not apply if mechanical contrivances are used for cleaning castings and the dust and particles arising therefrom are effectively removed at the point of origin by means of an exhaust system. Where tumbler mills are used, exhaust systems shall be installed to carry off the dust, except where the mill is operated outside the foundry. This regulation shall not prohibit the use of a water barrel to clean castings. Sand-blast operations shall be carried on in the open air or in a separate room used solely for such purpose. The milling of cupola cinders, when done inside the foundry, shall be carried on by an exhaust mill or water mill, each of a type approved by the Industrial Board. Cores shall not be blown out of castings by compressed air unless such work is done outside the foundry or in a special room or dustproof inclosure approved by the Industrial Board. Men employed in cleaning castings by compressed air or sand blast shall wear eye guards and helmets approved by the Industrial Board."

There is little to quarrel with in the provisions above quoted, despite the fact that the same delightful official vagueness as to means and methods is evinced. But the truth is that no standard plant for dust and fume removal can prove effective for all foundries; each must develop its own method in relation to its own conditions and restrictions. When owners of foundries realise that the department is as valuable and important as the machine shop, there will perhaps develop a school of engineers who will deal seriously with the problems of foundry lighting, heating and ventilation.

Foundry Lighting and Heating.

The Regulations above quoted also deal with lighting and heating, as follows:—"Where natural light is insufficient properly to light the foundry, artificial light of sufficient power shall be provided, in the discretion of the Industrial Board. Interior walls of foundries shall be whitened, in the discretion of the Industrial Board. Proper and sufficient heat shall be provided and maintained in every foundry. Open fires may be used for the drying of moulds or cores if coke containing less than 1 per cent. of sulphur is used; also charcoal, gas or oils may be so used; where practicable, such drying of moulds or cores shall be done at night. All hand and bull ladles shall be dried in ovens or outside of the foundry. Suitable facilities shall be provided for the thorough drying of employés' clothing."

In Great Britain we are not so accustomed to the necessity of heating arrangements in the foundry; but in America the severity of the winter practically necessitates the use of some means of warming the foundry in order to keep the sand fit for working. The open coke fire, however, is a rather objectionable expedient, though the one most frequently used. Hot-water and hot-air systems have been tried from time to time but have generally been discarded as being even more objectionable, either by reason of inefficiency or because of the odour created. The defect lies, in most cases, in attempting to attain too high a heat with insufficient apparatus. This results in the dust in the air being decomposed by contact with the hot apparatus, resulting in the objectionable smell so frequently accompanying the use of radiators. If the principle of heating the air drawn into the

building is adopted, also, the heating apparatus should be ample in size and the temperature of the warmed air relatively low, or the same objection will be experienced. A little systematic study of the heating problem for foundries, with a view to obtaining an unobjectionable and efficient system would be well repaid by the increased efficiency of men and materials during cold weather.

Pre-Historic Founders in Scotland.

The conditions of life and the development of various arts and crafts in the early days of the race are hidden in the obscurity of the past, for historical records cover only comparatively recent years. But from time to time the discovery of pre-historic remains unearthed from their depository of centuries ago throws some little light on the knowledge of our primitive ancestors. Of all such pre-historic remains probably none is more interesting than the specimens of metal work which are found from time to time, for the development of civilisation has been dependent on metallurgical development. Very interesting are the relics which were unearthed in the Isle of Bute in 1913 and 1914, for amongst them were specimens of metallurgical work apparently dating back long before the Roman occupation of Great Britain. These were recently mentioned again by Mr. Ludovic Maclellan Mann, who, writing in "The Glasgow Herald," remarked that the summit of the rock-mass called Dunagoil at the south-west corner of Bute has long been recognised as a vitrified fort, but its age was unknown. In 1913 and early in 1914 some test diggings in it, and in the cave on the shore beneath, whetted the curiosity of the members of the Buteshire Natural History Society. Further examination of the hill revealed many hundreds of humanly worked relics and amongst other remains a primitive bloomery or iron-manufacturing chamber, with its associated utensils, lumps of charcoal and the scoriæ of bog iron ore have been disclosed. Crucibles with bronze slag adhering, and baked clay moulds employed to cast objects of bronze, including a highly ornate socketed ferrule for the end of a spear-shaft, further testify to the nature of the metallurgical operations carried on within the citadel.

Of stone implements there are anvils, pounders, hammers (some of them perforated), smoothers, grinders, polishers, rubbers, and whetstones, made from porphyry, slate, hematite, quartz, quartzite, and other rocks. Valuable from the chronological and artistic points of view are decorative objects of glass, the colours used being yellow, mottled red, deep blue, white, and sea-green; a metal brooch of safety-pin type; and several large ring-headed pins of iron and bronze of corrugated surface, with shanks intentionally bent to facilitate their catch in the clothing or coil of hair. The iron objects consist of spear and hatchet heads, staples, rings, chisels, and awls.

If this site be carefully explored it is considered it may turn out to be one of the most important pre-historic stations in Britain. The absence, so far, of objects betraying Roman influence, the presence of the earlier form of grain bruising appliance, the evidence of futile attempts to construct the hand-mill of rotatory class, and the abundance of relics characteristic of the three centuries immediately preceding the opening of the present era seem to demonstrate that the fortress was occupied then, but was abandoned some years before the first intrusion of the Romans into Scotland.

British Steel Output in 1915.

Figures of production collected by the Statistical Bureau of the Iron, Steel and Allied Trade Federation from the steel manufacturers show that the make of Bessemer and open-hearth steel ingots in this country in 1915 amounted to 8,350,944 tons, as compared with 7,835,113 tons in 1914. The production during the last six years was comprised as follows:—

	Acid Bessemer.	Basic Bessemer.	Acid Open-hearth.	Basic Open-hearth.	Total.
	Tons.	Tons.	Tons.	Tons.	Tons.
1910 ..	1,138,103	641,012	3,016,830	1,578,536	6,374,481
1911 ..	887,767	573,373	3,131,118	1,869,354	6,461,612
1912 ..	980,662	541,825	3,365,570	1,908,087	6,795,144
1913 ..	1,048,772	551,929	3,811,382	2,251,793	7,663,876
1914 ..	797,072	482,444	3,680,848	2,874,749	7,835,113
1915 ..	821,408	479,816	4,090,752	2,958,968	8,350,944

The total Bessemer production last year was higher than in 1914 (1,301,224 tons, as against 1,279,516 tons) but was below the figure recorded for any other recent year. Open-hearth steel, on the other hand, with 7,049,720 tons last year, showed a bigger production than in 1914 (6,555,597 tons), or any previous year. During the year 1915 there were in operation 61 Bessemer-type converters and 489 open-hearth furnaces, while 35 converters and 103 open-hearth furnaces were idle.

In the year 1913 the output of steel ingots was 7,663,876 tons, which may be taken to be the rate of production at the end of that year. In 1914 the rate was increased by 171,237 tons, but it is probable that the rate of production at the end of 1914 was no greater than the average output throughout the year. In 1915, however, not only was the output increased by 515,831 tons of ingots, but it is certain that the rate of output was greater at the end of the year than the average of the year, and we look to see a still further increase in the output of ingots during this year.

While the Bessemer steel industry has not so greatly declined during the past few years, on the other hand it shows great signs of decay now by reason of the fact that the firms whose output has been of the Bessemer variety are not now extending in that direction, but are increasing production by building open-hearth steel plants. This tendency has been even more marked during the past year than previously. The output of Bessemer steel during the past five years has been as follows:—1,461,140 tons in 1911; 1,522,487 tons in 1912; 1,600,701 tons in 1913; 1,279,516 tons in 1914; 1,301,224 tons in 1915.

In the early 'nineties the output of Bessemer steel was over 2,000,000 tons, and in good years of trade since, the output has approached within 100,000 tons or so of the 2,000,000 mark, but the last two years have been the smallest in point of tonnage since the early days of the Bessemer process, and with the extension of open-hearth-making capacity it is very doubtful if the Bessemer steel trade will ever again see the rate of output of even the last five years. The production of basic Bessemer ingots, which, following the 1900-1 boom, grew comparatively rapidly, is now falling again, and the output of acid Bessemer shows a more or less continuous decline over 25 years. In spite of this, the Bessemer process has under certain conditions a great field open to-day, and its advocates in Luxemburg and in Germany would not readily concede any advantage to the Siemens' process. British conditions, however, favour the latter process.

B

Production of Castings for Internal-Combustion Engines.—I.

By Joseph G. Horner, A.M.I.Mech.E.

The Question of Putting Out Castings.

Many motor builders send their castings to be made out in distant foundries where work is done for the trade. This seems to be an undesirable practice, unless under exceptional conditions. Profits can be made in a foundry just as in other departments; but the sacrifice of profit is of lesser moment than the risk of errors which are liable to creep in when work is cast away from the firm who gives it out, and—which is also as objectionable—when unnecessary alterations are requested, or when the blame for wasters is laid at the door of the pattern-maker. There are few patterns which do not readily admit of alternative methods of making and moulding. Some men prefer to core parts which others would leave to deliver themselves. One man will joint in one direction, another

FIG. 1.

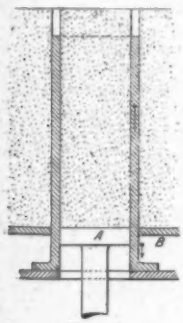


FIG. 2.

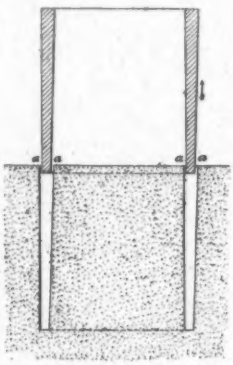


FIG. 3.

at right-angles thereto, while some would not joint the pattern at all but only the mould. So with core boxes; these can usually be constructed in more than one fashion, or their employment be dispensed with by the substitution of sweeping or strickling. Details of this kind can be and are daily discussed and settled between the foreman of the pattern shop and the foundry, when necessity seems to arise, and can be determined before the construction of the pattern is commenced. But when patterns are sent away, good methods are often called in question, and time may be wasted in a journey entailing a possible expensive and unnecessary alteration. This may be required merely to utilise some existing tackle or machines in the foundry.

But on the other side something can be said in favour of casting out. When the volume of work is rather small, when capital is limited, when the heads of a firm have had no experience in foundry work, but would have to trust wholly to a foundry manager, it is better to walk warily, and at least postpone the installation of a foundry with its expensive plant until conditions may appear to warrant the outlay. And then a commencement may be made with an iron foundry only, to be followed with another for brass and aluminium, and finally perhaps in some cases another for steel. The methods adopted, the controlling conditions, the hands, differ in each, notwithstanding that the principles underlying the actual work of moulding, the machines used, and the construction of the patterns, are identical in all.

The Patterns.

Again, if a firm elects to send its castings out it seems better that the pattern work should be done away also. The experience of the few pattern-making firms who work for the trade enables them to do this better and often cheaper than the average hands do. Their experience is specialised, they possess large seasoned stocks of material, and adopt so thorough a division of labour that special aptitudes and economies go hand in hand. Patterns of wood, of metal, and for machine moulding, preparatory roughing, and high-class finishing, are distributed between different hands as far as possible. The expenditure on numerous machines, both for general and for special operation, is

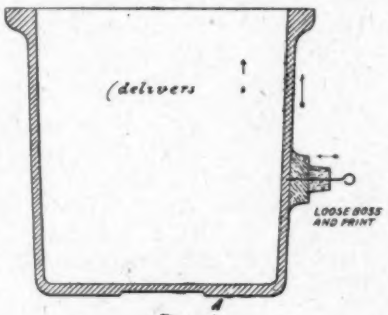


FIG. 4.

greater than is usually allotted in the ordinary pattern shop.

Even when a firm has its own foundry there are some patterns which are made better or more cheaply if put out. For pattern work is now becoming specialised. Gear wheels are a case in point. Firms who are equipped with machines for cutting the teeth of pattern gears make them more accurately and at much less expense than hand-cut gears, and especially so with bevels and worm wheels. So in intricate bend and core-box work, the wood-working machines supplied by two or three firms enable intricate sections and curves to be produced rapidly and in a manner superior to the most careful hand-work. Small pattern shops cannot afford to buy these machines. The metal pattern and core-box work, too, for motor cylinders calls for a very high degree of skill. Work must be done within about a hundredth of an inch to avoid the inequalities which, if present, would result in unequal cooling, distortions and fractures.

The Forms of Patterns.

To those whose experience of foundry work is limited by casual observation, the subject of delivery of patterns, and all which that entails, is

one that seems to bristle with difficulties. Why in some cases is a pattern made like its casting; why are cores used in others; why do the shapes and proportions of core prints differ so widely; what governs the fitting of loose pieces at the top and on the sides of patterns, what is the meaning and what are the functions of the many skeleton-like frames, grids, drawbacks and the rest, which are associated with some cores and moulds? Questions of this kind continually arise, and in this article therefore we may profitably touch briefly on many of the principal reasons for making these differences, before proceeding to discuss the actual work of moulding.

Delivery of Patterns.

Patterns are constructed like their castings, either when no interior portions are present (Fig. 1) or

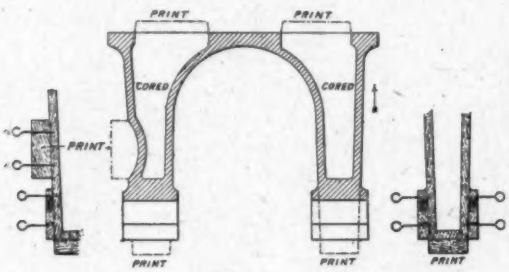


FIG. 5.

when such portions can be readily delivered from the sand, or, which amounts to the same thing, when the sand can be removed from them. These conditions exist when no parts are undercut in relation to the plane of the lift, and then only when the dimensions of the sand, such as its width or diameter relatively to the depth, are large enough

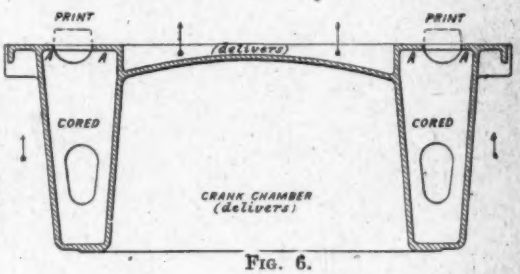


FIG. 6.

But these broad facts are modified by others. The sides of a pattern may be amply tapered, and still a lift of the sand be undesirable or impracticable. The moulder's axiom that the faces which must

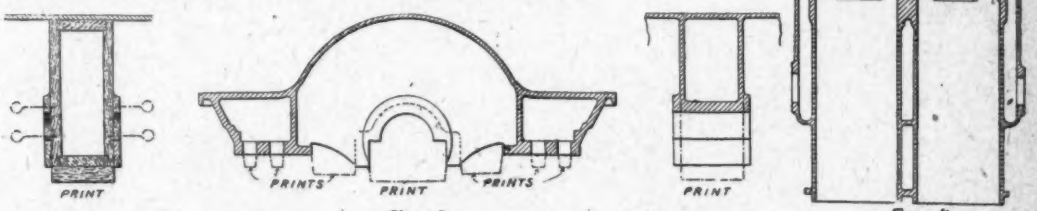


FIG. 7. FIG. 8.

to guarantee coherence in the mass. Thus a hole 1 in. or 1½ in. diameter and 6 in. deep (Fig. 2), could not be delivered by hand-lifting alone, while another 6 in. diameter and of the same depth (Fig. 3), could be, provided a little taper or reduction in size were allowed.

Taper.

Taper is thus a most important controlling fact. The moulder likes to have plenty of it, but generally in castings its amount must be very slight. But enough must be allowed to relieve the pattern from the pressure of the sand during its withdrawal, since perfectly parallel edges would bind against the sand as hard and tightly just before delivery as at the commencement of the lift, and that would cause the edges of the sand to fracture or "pull up." In Fig. 3 the pattern is seen just leaving the mould, and the clearance between it and the sand provided by the taper at *a*, *a*, is shown. In Fig. 2 a feature is included by which delivery of a core much longer than that shown can be effected, that of a piston, *A*, supporting the sand against its tendency to fracture by the frictional effect of the pattern, here being drawn downwards. In this case no taper at all is required. Also the sand is sustained against the outside by means of a stripping plate *B*, and here also no taper is necessary. But these are machine methods and do not apply to the ordinary hand-made moulds, which we are now discussing. In Fig. 1 a hole is cast in the cover. This is so shallow that it will deliver easily with a trifle of taper, so that a core is unnecessary here. It is therefore clear that the conditions which are most favourable to self-delivery are the presence of sloping faces, or of hemispherical, or cylindrical interiors, and not vertical ones, and after that of shallow vertical ones. The more nearly shapes approximate to the sloping or the curved forms the better for self-delivery.

have the soundest metal must be cast downwards also influences methods. In the engine-base section (Fig. 4), the interior might, and would, be generally lifted out in green sand and the outside of the pattern be withdrawn from the mould as indicated by the arrow, provided other details of the bed did not enter to complicate matters, as they generally do. The bed section taken through the crankshaft bearings (Fig. 5) is one example of this kind. The outside delivers readily enough, but the inside should be cored, if for no other reason than that the sand is both deep and narrow. In Fig. 6 all the interior of the crank chamber will deliver downwards. The sand in the shallow recess above can be lifted with the top box, but the interior of the flanking sides cannot deliver although ample taper is present, because the return flanges *A*, *A*, prevent it. These therefore are cored, cores being located by the prints above, assisted by chaplets elsewhere. In the crank case (Fig. 7) the actual chamber will deliver readily, though it is as often

cored, but the feet at the sides must be cored, each core being conveniently carried in two impressions and the space behind the bearing also. Further reference will be made to these illustrations.

Cores.

In the majority of instances interiors which in the main are favourable to delivery are associated with other details which are not so. Or often, as in cylinder castings, no portions at all will deliver (Figs. 8 and 9), and then an interior mould—the core, or rather an asemblage of cores—must be inserted. In nearly all cases these have to be rammed in boxes which are entirely distinct and separate from the pattern. When the interior

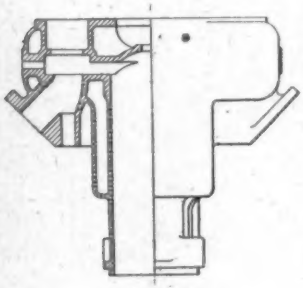


Fig. 9.

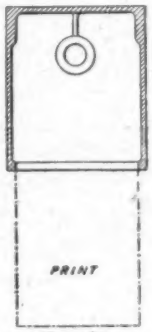


Fig. 10.

delivers from the pattern as in Fig. 4, the term green-sand core applies, though the two kinds have little in common. To locate cores in their correct positions in the mould they have to be inserted in the impressions formed by core prints, which are attached to the pattern, as indicated by the dotted

Fig. 14.

Fig. 15.

lines in several of the figures. Further, any inaccuracy which occurs in the setting of these prints on the pattern will be reproduced in the mould and the casting.

Yet though correct setting is sufficient in the average run of ordinary moulds, additional care is necessary in the best work, because cores tend to come out of their boxes very slightly under size and print impressions in the moulds slightly over size. Cores also become distorted in drying. Lapping joint edges are liable to occur both in moulds and cores. Corrections have to be made when these exist. Long cores sag in the mould because of their weight, or they become pushed upwards and distorted by the pressure of the liquid metal. To the same cause is due the shifting of vertical cores at localities away from the coercive influence of the print impressions. These facts explain why prints are made longer in some cases than in others, until in extreme instances they are as long as the core which they sustain; and why, too, the core supports are multiplied when the metal is very thin, even though the cores may be of great length. Figs. 10 to 12 illustrate some of these points. Figs. 10 and 11 show a piston casting in two views at right angles. The interior is properly made in a core, in a box separate from the pattern. In a

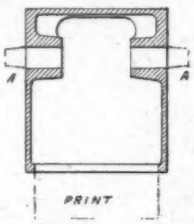


Fig. 11.

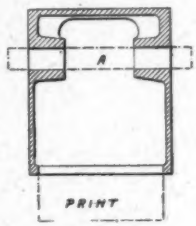


Fig. 12.

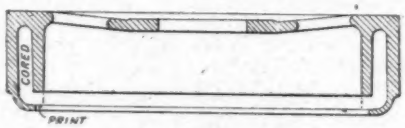


Fig. 13.

small casting in which the holes for the gudgeon pin are not cored, but drilled through the solid metal, the core print must be as long as the core itself, as indicated in Fig. 10. But if these holes are cast, the print will be comparatively short, as in Figs. 11 and 12, because support is afforded to the main core elsewhere by the prints *A*, *A*. In Fig. 11 the separate cores *A*, *A*, are set in top and bottom. In Fig. 12 a hole *A* is pierced through the main core through which a single core for the gudgeon pin holes is thrust, and the core inserted as one piece. Or two separate cores might be inserted into the main one. In either case the main core receives support in three places. The main cores in Figs. 8 and 9 are also supported at both ends, the large diameter in print impressions in the mould, the small necks in the jacket cores. These, too, are carried by prints located sufficiently far apart to afford good support.

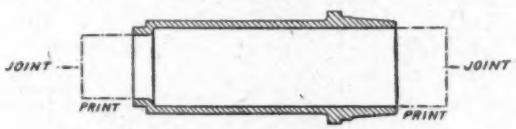


Fig. 16.

The casting in Fig. 13 has to be cored. Though the print bearing is very narrow, yet the large circumference compensates for that, and affords good sustenance to the core. So intricate is the coring in many castings, as in Figs. 8 and 9, that the time occupied is double or treble that spent in making the mould; and other difficulties arise in connection with setting and securing the cores in order to ensure free venting and to avoid all the risks of the cores becoming shifted out of place during pouring.

Core Prints.

The explanation of the reasons for the different forms of core prints seen is to be found essentially in the positions which the cores occupy in relation

to the mould. Vertical cores are carried in vertical prints which have actually the same shape in cross-section as that of the cores. Thus a round print carries a cylindrical-shaped core (Fig. 14), a square one carries a square core, and so on. If a core is very long it is supported by a top print in addition (Fig. 15). A core which is disposed horizontally also has round prints when the joint of the mould coincides with the longitudinal axis or centre of the core as in the liner (Fig. 16) and the piston (Figs. 10 to 12). But if otherwise, some few special cases excepted, the pocket or drop form of print is used (Fig. 17). In this only the lower portion of the print corresponds with the sectional shape of the core. Above that the print is carried up tapering to the top of the pattern or to wherever the mould joint happens to come. This supplementary portion has to be filled or "stopped over" with sand after the core has been inserted (Fig. 18). Or in standard work the core box is made to include the stopped-over portion in one piece with the actual core. The alternative to a drop print is to make a sloping sand joint from the top of the mould down to the centre of the core (Fig. 19) and lift that portion in the top. But as the lift on the face of the pattern would be perpendicular this is not done unless the drop is very slight.

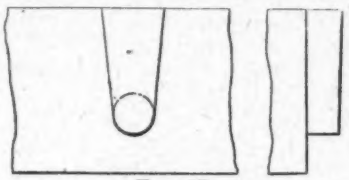


Fig. 17.

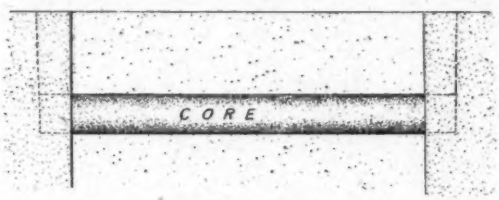


Fig. 18.

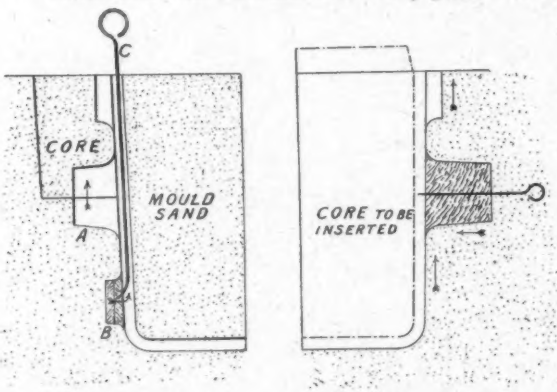


Fig. 21. Fig. 22.

But if horizontal cores happen to be very short, as when they are inserted in bosses on the sides of patterns (Fig. 4), then round prints carry them. But the prints and bosses must be loose, to be drawn into the mould in a horizontal direction subsequently to the withdrawal of the main pattern. This suggests the employment of loose pieces.

Loose Pieces.

Whenever a portion of a pattern occurs at one side of a vertical lift and below the joint face so that it is covered over with sand, it cannot be lifted along with the pattern without pulling up the sand above it. Then usually it is made as a loose piece (Figs. 4, 5, and 7), though sometimes it is cored over. In Fig. 5 a core print also is attached loosely to take out the recess to clear a gear on the lay shaft. This recess obviously would, if cut in the pattern, interfere with its delivery. Loose pieces are objectionable when high accuracy is necessary, on account of their liability to become shifted slightly out of place during the ramming of the sand surrounding them. They are held only temporarily by wires or by screws, or in the best work and where their positions permit, with freely sliding dovetails, until the sand has been rammed around them, so that risk of shifting is always present. For this reason a method which is frequently adopted is to place a print above the portion on the side and make the pattern and print fast to the side and withdraw them along with the main body of the pattern (Fig. 20, right hand). Then a core is made to fill the print and form the

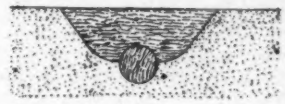


Fig. 19.

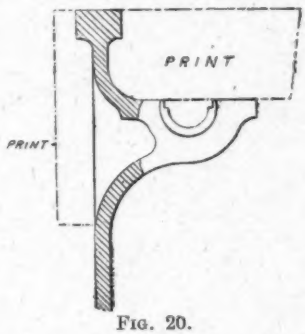


Fig. 20.

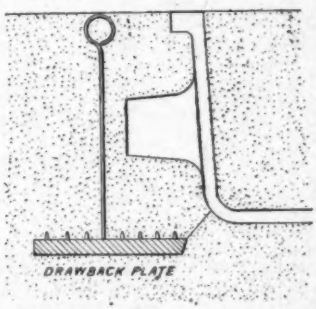


Fig. 23.

upper part of the portion covered over by it. The same figure shows a loose print for taking out a recess.

A loose piece cannot be utilised unless a mould space exists large enough to contain the loose piece when drawn in laterally; 6 in. obviously cannot be drawn into 5 in. When a mould has thin sides, say 1 in. thick, formed in mould sand (Fig. 21), as distinct from cores, a boss *A*, or a fillet or a bearing 2 in. thick cannot be drawn into them. Then the boss must be cored over, or, when practicable, provision must be made for removing the interior portion of the mould bodily on a grid to permit of the bringing inwards of the loose piece. But pieces which are slightly thicker than the space into which they have to be drawn can be got in by making them in two or three thicknesses, as is often done (Fig. 21, *B*), though that is not a very good method. But even that is impracticable if the loose piece is situated low down in a deep mould, whence its withdrawal by a pointed wire *C* would be troublesome, and subsequent mending up impossible. The most favourable condition for using loose pieces is when the interior of a mould is open, as is the case when it is formed with separate cores (Fig. 22). Then the loose pieces are drawn in and the mould blackened and cored before the main core (indicated in dotted outline) or cores are inserted.

Where these extraneous pieces are both numerous and stand out to considerable distances, the alternative is to carry the outer portions of the mould with pieces *in situ*, on drawback plates (Fig. 23), or on a surrounding grid or framing, which is substantially the same device. The objection to both of these is the risk of not getting the plates or the frames back into the precise positions which they occupied during ramming. But these methods have much to recommend them in the heavier kinds of work. The faces of the mould can be dealt with individually and easily. Cleaning up, drying, blackening, and some coring can be done without having to bend over a mould. With the exercise of due care in resetting, a higher degree of accuracy is possible than if the work is done when the workman is hampered by the parts of the mould adjacent.

(To be continued.)

ELECTRIC TAPPING OF BLAST FURNACES. — An ingenious method of tapping blast furnaces is stated to be used at the Edgar Thompson works of the United States Steel Corporation. An electric arc is drawn between an electrode and the chilled metal in the tap hole; the heat of the arc burns through the chilled metal, until the fluid contents of the furnace are reached. If during the opening operation non-conducting material is encountered, it is necessary to stop the arc and drive a steel bar through this mass. The process of melting is then continued, the arc following the bar of metal. A 250-volt circuit is used, the pressure being reduced by means of a water rheostat. A current of from 800 amperes to 1,000 amperes is ample for the operation. The apparatus used consists of a special electrode holder, electrodes, cable, a resistance, and a head shield or protector for the operator. The length of the electrode and holder is about 12 ft.

COATING IRON PATTERNS.—A method of protecting iron patterns from rust is to coat them with a mixture composed of 1 pint of turpentine, 1 gallon of paraffin oil and sufficient vegetable black to render the solution thick like ordinary paint. The mixture is rubbed on the pattern, after which they may be used many times and still be as smooth as new.

Corrosion of Metals.

Institute of Metals Report.

At the annual meeting of the Institute of Metals, held at Burlington House, Piccadilly, W., last month, the Third Report to the Corrosion Committee of the Institute was presented by Messrs. William E. Gibbs, M.Sc. (Special Lecturer in Metallurgy in the University of Liverpool), Richard H. Smith (late Wiggin Scholar in Metallurgy in the University of Birmingham), and Guy D. Bengough, M.A., D.Sc. (Lecturer in Metallurgy in the University of Liverpool). In a preliminary note the Corrosion Committee explain how the work has been interrupted and rendered difficult by the war, and indicate the share taken in the research by the three compilers respectively. The Report is a volume of some 127 pages, and records work on the corrosion of condenser tubes that has been done with the Institute's experimental plant at Liverpool. To condense the mass of practical information it contains is not an easy matter, for even the authors' summary runs to seven pages—a Paper in itself. However, it may briefly be recorded that the sea-water corrosion of ordinary brass (70 per cent. copper, 30 per cent. zinc) at 30 deg. C., 50 deg. C., and 60 deg. C. has been compared with that of Admiralty metal (70 :29 :1), a special lead-brass (70 :28 :2), phosphor-bronze (96 :4), and aluminium-copper (92 :8). It is found that aluminium-copper dissolves more slowly than the brasses. The phosphor-bronze dissolves more rapidly than the brasses. In each case both hard-drawn and annealed test-pieces of the alloys were used. Generally speaking, the hard-drawn metal dissolved less rapidly than the annealed, but is more readily attacked locally and selectively. Aeration of the sea-water accelerates the rate of corrosion, more especially at the lower temperatures. Corrosion in gently aerated diluted sea-water (*e.g.*, estuary water) has been examined in some detail. The rate of solution of each alloy is diminished by diluting the sea-water, but the degree of selective corrosion is greatly increased. It is found that the rate of solution of pure copper is diminished by diluting the sea-water, and is least in distilled water. That of pure zinc is greatly increased by diluting the sea-water, and is greatest in distilled water.

Diluted sea-water also facilitates the formation of deposits of oxy-salts of zinc upon the surface of the metal. These oxy-salts are found to promote local selective corrosion. In diluted sea-water the phosphor-bronze is the most satisfactory of the alloys considered.

The corrosion of the above-mentioned five alloys has also been examined in distilled water saturated with carbon dioxide, at 30 deg. C. and 50 deg. C., and in a 0.15 per cent. solution of common salt, at 30 deg. C. and 50 deg. C. Dezincification is promoted by a low concentration of salt, and by a relatively high concentration of carbon dioxide. Contact with coke is found to promote dezincification of the Admiralty metal, provided that good electrical contact exists between the metal and the coke. Under service conditions good contact is probably the exception rather than the rule.

The influence of the surface condition of the metal has been investigated, and is shown to be important during the early stages of the corrosive attack. The corrosion of 70 :30 brass has been compared with that of pure zinc and copper.

The Report contains a section which is devoted to a consideration of the bearing of the results of the experimental work upon the practical problem.

Blast-Furnace Working and the Function of Slags.*

By J. E. Fletcher.

It is recognised that regularity and uniformity of charging methods in blast-furnace working are of all importance. To take a concrete case, a furnace working on phosphoric ores has a diameter of 11 ft. at the stock line; the cold charged ore, flux, and coke are, say 3 in., 1 in., and 10 in. thick respectively. Now clearly, with mixed ores containing, say, 50 per cent. of lumps averaging 4 in. to 5 in. cubes, and 50 per cent. of fines, with limestone charged in lumps varying from fines to 4 in. cubes, it is not conceivable that the limestone can uniformly distribute itself over the mixed ore. The limestone lumps obviously fall in the gaps between the ore lumps, and when afterwards in the descent the limestone calcines, the fine lime is most intimately mixed with the fine portions of the ore, and the large ore lumps are very liable to be left isolated, to catch what lime they can.

As the charge descends and the limestone is calcined, the lime occupies about double its original bulk and tends to somewhat correct the above-mentioned evil, but there can be little doubt that the iron reduction begins first in the fine ore clots, in the path of the reducing gases which carry off some of the fine lime, coke and ore into the downtakes. Before the iron reduction takes place the ore, lime, and fuel bulk has increased by about 20 per cent. owing to the increased lime bulk and the slight expansion of the ore and fuel. At the point when iron reduction begins there must be a quick contraction and by the time the top of the boshes is reached the bulk of the ore, lime and coke will probably be about 15 per cent. greater than when charged. This shrinkage during the descent through the body of the furnace aids the ascent of the gases, and would be more pronounced but for the fact that carbon deposition during the reduction of the iron helps to slightly swell the mass. It is probable, however, that as this deposited carbon may be the means of carbonising the reduced iron, the shrinkage will continue into the neighbourhood of the boshes. Where the lumpy ore and large limestone lumps happen to fall together there may be retarded reduction and calcination, and the two may fall into the hearth before being assimilated. And generally, as the lumpy ore is not reduced until lower down the furnace than the fine, the time of travel is not sufficient for complete carbonisation and the resulting pig-iron will be low in total carbon. Again, such a succession of accidents as are above brought about by the presence of too large lumps of ore and limestone, and the quicker travel and reduction of the fines, must tend towards slipping, causing successive " jams " in the body of the furnace.

Natural Slags.

The intimacy of contact between the silica, lime, alumina, etc., in the gangue of an ore must make for the primary formation of slags having often very different compositions to that of the final slags which run from the slag notch, and when using mixed ores there must be formed in the boshes a variety of slags each resulting from its own ore. These slags, later, when seizing on the available lime in their immediate neighbourhood, run down into the hearth, and mixing together form the final slags.

The " gangue " slag formed from a " limey " Lincolnshire ore is of the easily fusible fluid type with about 45 per cent. of SiO_2 and 14 per cent. Al_2O_3 softening at about 1,355 deg. C., whereas that from a Scotch Blackband ironstone, owing to the high alumina content softens at a higher temperature (1,440 deg. C.). A mixture of two such ores would probably result in uneven reduction and descent. The first would soften and begin to flow down into the boshes before the second softened. Further, as the contact with the free lime would commence first with the Lincolnshire ores as they slipped into the hotter zones of the boshes, liquidity of both reduced iron and slag would progress with far more rapidity than would be the case with the Scotch ores alone. If, therefore, during charging, the above ores were so distributed as to descend, the one ore on one side of the furnace and the second on the other side, the smelting would proceed unevenly and the quality of the product would be affected.

Influence of Fuel Ash and Lime.

As the iron commences to reduce it descends more rapidly than the gangue, the surface of which is left open to the influence of the surrounding lime. If the ore is not too lumpy it is clear that as the iron is reduced it facilitates the formation of homogeneous (more or less) slags because the honeycombed mass of gangue, from which iron particles are escaping, is free to the attack of the CO gas and to the contact with the free lime which surrounds it. Here again the possibility of irregular descent is seen, for where lumpy ores and a shortage of adjacent lime occur in clots or colonies, there local silicious or " scouring " slags are liable to occur. The shortage of lime in such areas leads to oxidation of iron, and slag clots high in iron oxide are formed when such occur next the boshes or lining, the brickwork being robbed of silica to satisfy the hungry demand of the ferrous silicate.

As the gangue or earthy matter of the ores descends into the boshes the temperature becomes high enough to fuse it, and each ore produces initially a natural slag of its own. As it descends further into still hotter zones in contact with the free lime the slag composition changes, each temperature reached corresponding to the equilibrium of the slag formed, the volume of the slag progressively increasing as the hearth is approached.

It is possible that a certain amount of metalloid reduction takes places before reaching the hearth or tuyere region, seeing that there must be contact between the particles of reduced and carbonised iron and the slag as they descend together. The iron, more or less eutectic, being fluid in the boshes flows more rapidly than the slags, and on this account cannot absorb silicon, phosphorus or manganese to any great extent until it meets larger bulks of slag. The reactions between iron and slag depend largely upon the carbon present in the molten iron. Thus silicon is reduced according to a reaction of the type :—$2Fe_3C + SiO_2 = 2CO + Fe_2Si + Fe$, silicide of iron entering the pig-iron. Similarly manganese is reduced :—$6Fe_3C + 3MnO = 3CO + Mn_3C + 3Fe_3C$

*Abstract of Paper read, March 25, before the Staffordshire Iron and Steel Institute.

$+9Fe$; and phosphorus—$3Fe_3C+P_2O_5+4CaO=2Fe_3P+3CO+4CaO+2FeO+Fe$, the $2FeO$ being further reduced $2FeO+2C=2CO+2Fe$.

The entrance of Si, Mn and P into the pig-iron is thus seen to be an exchange between the oxides of silicon, manganese and phosphorus and carbide of iron. Silicide of iron Fe_3Si, carbide of manganese Mn_3C, and iron phosphide Fe_3P, are the forms in which the elements Si, Mn and P. are finally found in the molten and solid pig-iron.

Effect of Progressive Absorption of Lime by the Descending Gangue Slags.

In the case of ores containing small lime percentage the natural slags are, of course, highly silicious and rapidly absorb lime until a slag containing from about 33 per cent. to 37 per cent. of lime is formed, after which, if lime is available, the lime content increases slowly. When the character of the slag changes from acid to basic the slag rapidly becomes viscous and of higher fusion temperature. This change begins when the sum of the basic oxides CaO MnO and MgO exceeds 50 per cent. to 55 per cent. The slags then formed readily fall to powder on cooling, especially if the lime content exceeds 48 per cent.

Where the ores contain high lime or manganese, the gangue slags are very fusible, being of the order :—SiO_2 45; Al_2O_3 15; CaO 35; MgO 2; MnO 2 per cent.; and having a softening temperature of about 1,360 deg. C. To more clearly show the effect of progressive absorption of lime Table I. has been compiled. Here a hematite has been taken as an example. The natural slag has a softening temperature of 1,380 deg. C. It rapidly absorbs lime until 36 per cent. ($CaO+MgO+MnO$) appears in the slag, the softening temperature of which is low (about 1,310 deg. C.). As the temperature increases

TABLE I.

	Lime added per 100 lbs. ore.	SiO_2.	Al_2O_3.	MgO.	CaO.	MnO.
(a)	Gangue	9.5	1.2	0.2	1.2	0.9 lbs.
	Gangue	73.0	9.5	1.5	9.2	7.0 %
	5 lbs.	52.7	6.7	1.1	35.5	5.0 ,,
	10 ,,	41.5	5.2	0.9	48.7	3.7 ,,
	15 ,,	34.0	4.3	0.7	57.8	3.2 ,,
	Gangue + Coke ash	12.5	2.2	0.2	2.0	0.9 lbs.
(b)		70.0	12.4	1.2	11.2	5.2 %
	5 lbs.	54.5	9.7	0.9	30.9	4.0 ,,
	10 ,,	45.0	8.0	0.7	43.0	3.3 ,,
	15 ,,	38.2	6.7	0.6	51.8	2.7 ,,
	20 ,,	32.6	5.8	0.5	58.0	2.1 ,,

(a) Addition of lime to gangue. (b) Addition of lime to gangue and ash.

and lime continues to be absorbed the slag quickly becomes more basic, especially if the temperature exceeds, say, 1,450 deg., until 50 per cent. of CaO and basic oxides are held in solution. In the lower part of the Table I. the influence of coke ash in the slag formation is seen. An ore smelted with 1 ton of coke (8 per cent. ash content) per ton of pig-iron produced has been taken, the addition from the coke ash being assumed to be (per 100 lbs. of ore charged) SiO_2 3 lbs., Al_2O_3 1 lb., CaO 0.8 lb., the weight of natural slag increased by the coke ash addition being raised from 13 lbs. to 17.8 lbs. per 100 lbs. of ore charged before further lime is absorbed.

The diagram Fig. 1 shows graphically the progressive charges in the hematite slag analysis as lime is added. The curve A, B, C, D, indicates the softening temperatures of the slags. The line X X shows the alteration in the proportion of ore to flux as lime is added.

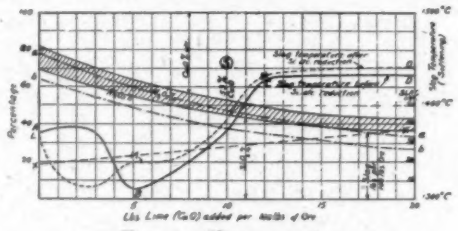


FIG. 1.—HEMATITE ORE.

This diagram, which is typical of all ores with gangues poor in $CaO + MnO + MgO$, is of particular interest. It reveals a critical point B, the analysis at which point indicates a slag condition peculiarly sensitive to heat. With the minimum rise in temperature of the hearth such a slag will reduce silicon from the slag most readily, and probably manganese and phosphorus also. It further graphically explains the effect of the rapid change which takes place when the slag approaches the basic condition, the latter slags having higher fusion temperature. Once the change point C is passed the fusion temperatures are fairly constant, though undoubtedly the liquidity decreases as the basicity increases.

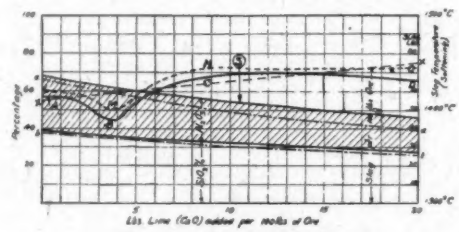


FIG. 2.—CLEVELAND ORE.

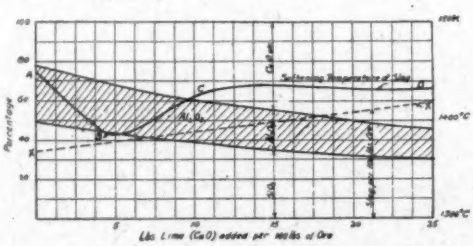


FIG. 3.—SCOTCH BLACKBAND ORE.

Figs. 2, 3, 4 and 5 similarly represent the changes in slag conditions during the smelting of Cleveland, Scotch Blackband, Northampton and Lincolnshire (limey) ores.

The influence of alumina in these slags is clearly seen, the critical point varying with the percentage of alumina. This constituent of slags has been often considered as a base or as neutral. Whilst

it is true that alumina is not reduced, its action is distinctly acid in its nature and it undoubtedly acts with silicon in producing grey iron. When silicon or aluminium are added to pure white iron (eutectic) grey iron results. The author has proved

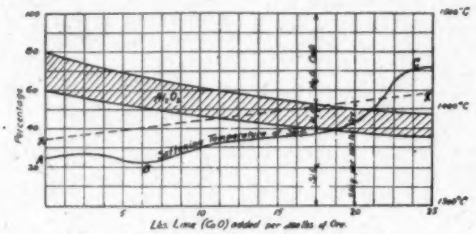


FIG. 4.—NORTHAMPTONSHIRE ORE.

that 0.8 per cent. aluminium produced the same greyness as 2.5 per cent. of silicon. The slags of greatest fusibility are those containing 10 to 15 per cent. of alumina. In practice the alumina content may reach 25 per cent., but when the lime and magnesia content reaches 55 per cent. or above

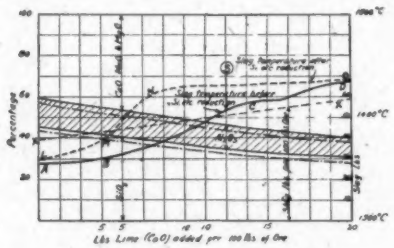


FIG. 5.—LINCOLNSHIRE ORE.

with 20 per cent. to 25 per cent. alumina, the slags fall to powder on cooling, and thus indicate sluggishness and lack of liquidity. The presence of magnesia when in less proportion than half the lime content lowers the temperature of the slag formation, and generally increases the liquidity. Manganese oxide also lowers the fusion temperature, and greatly aids the liquid condition.

Reduction of Silicon, Manganese, and Phosphorus.

It is possible to foretell the alteration in the slag analysis caused by the reduction of the metalloids. Suppose such an ore as in Table I. is reduced, and by means of temperature control the silicon content in the pig-iron becomes 2.5 per cent., half the manganese being reduced from the slag, and all the phosphorus therefrom. The 100 lbs. of ore are associated with varying bulks of slag dependent on the lime additions. In this case 60 lbs. of iron are reduced, and there are added 1.5 per cent. of Si abstracted from the SiO_2 of the slag, and 0.36 lb. of Mn. The SiO_2 removed from the slag is therefore 3.2 lbs. and the MnO removed is 0.46 lb. Table II. shows how the various slags formed by the addition of increasing amounts of lime would be modified after the reduction of silicon and manganese had taken place. These results are shown on the curve in Fig. 1 by the dotted lines *aa*, *bb*. The resulting slags have higher fusion points which are indicated by the curve L, M, N, O.

The importance of these facts can hardly be overrated. They draw attention to the fact that a very slight rise in temperature of hearth is sufficient with some slags to reduce silicon. A well-known blast-furnace expert states that a difference of 32 deg. F. in the hot-blast temperature will often cause a variation of 0.1 per cent. in silicon in a pig-iron. The ores with but little gangue, and

TABLE II.

Lime, lbs. added Per 100 lbs. Ore.		SiO_2	Al_2O_3	P_2O_5	CaO	MgO	MnO	Slag per 100 lbs. Ore
HÆMATITE	0 lbs.	19·5	2·2		2·0	0·2	0·2	17·8 lbs.
	%	70·0	15·4	...	11·2	1·1	5·3	%
	5 lbs.	54·6	9·6		30·2	0·2	4·0	23·8 ,,
	(a)	48·5	11·5	...	36·3	0·7	3·0	%
	10 lbs.	45·0	7·9		43·2	0·7	3·2	27·8 ,,
	(a)	38·3	9·1	...	49·6	0·8	2·2	%
	15 lbs.	38·2	6·7		52·0	0·6	2·5	32·8 ,,
	(a)	31·8	7·6	...	58·2	0·7	1·7	%
	20 lbs.	33·2	5·8		58·2	0·5	2·3	37·8 ,,
	(a)	27·0	6·4	...	64·5	0·6	1·5	%

Analyses marked (a) indicate slags resulting from the reduction of Silicon, Pig Iron containing 2·5 % Si being made.

CLEVELAND	Lime 10 lbs.	SiO_2 29·0	Al_2O_3 14·5	P_2O_5 1·6	CaO 18·0	MgO 5·0	MnO 1·0	Slag, lbs. 60·1 lbs. slag
Before reduction of Si		33·5	24·0	2·6	30·0	6·8	1·6	
Making 1% Si pig-iron		33·3	25·2	...	29·5	8·7	1·8	57·4 ,, ,,
,, 2 ,, Si ,,		32·3	25·1	...	31·8	8·8	1·4	56·5 ,, ,,
,, 3 ,, Si ,,		31·2	28·0	...	32·4	9·1	1·3	55·7 ,, ,,
	Lime 20 lb.	20·0	14·5	1·6	23·0	5·0	1·0	70·1 ,, ,,
Before Si reduction		28·5	20·7	2·3	40·0	7·1	1·4	
Making 1 % Si iron		28·4	1·6	...	41·5	7·4	1·2	67·4 ,, ,,
,, 2 ,, Si ,,		27·3	1·7	...	42·2	7·5	1·1	66·5 ,, ,,
,, 3 ,, Si ,,		26·5	2·2	...	42·7	7·6	1·0	65·7 ,, ,,

which require but little time to flux them, alter most in character during the reduction of silicon. Thus with hematite ore, the slag which on entering the hearth has a SiO_2 content of 45 per cent. and CaO 43 per cent., on leaving the slag notch, after yielding a grey pig (2½ per cent. Si) has the 38 per cent. SiO_2, and 49.5 per cent. CaO. A Northampton iron demanding twice the flux for its working has its slag composition changed from SiO_2 37.6 per cent., CaO 44.5 per cent. on entering the hearth to SiO_2 36 per cent., CaO 48 per cent. on leaving the slag notch after yielding a grey pig of 2.5 per cent. Si. The greater the slag volume the less is its composition affected during silicon reduction, and providing the slag composition allows of a sufficient liquidity, the product is likely to be more regular. When the sum of silicon and alumina per cent. does not exceed 50 and is less than 45 the slags are fairly fluid (if the Al_2O_3 content does not exceed 15 per cent.). With higher alumina the slags are more refractory and are dense and hard, and grey in colour when solid. The most sensitive slags, therefore, are those :—(1) Whose composition varies most per 1 per cent. of Si transferred to the pig-iron from the slag. (2) Whose temperature of fusion varies most per 1 per cent. of Si transferred from the slag to the corresponding pig-iron.

The sensitive point in the slags examined has been marked on the diagrams by the letter "S," and this occurs when the sum of the Al_2O_3 and SiO_2 in the slags is about 53 per cent.; and generally it may be remarked that when the sum of SiO_2 and Al_2O_3 exceeds 55 per cent. the slags, owing to their strongly acid nature, are very liable to absorb ferrous oxide in preference to lime, and become scouring in their action. With the lime content of 36 per cent., or thereabouts, the lowest fusion point and highest fluidity occurs. At the sensitive point "S," Al_2O_3 SiO_2 = 53 per cent., the slags are most sensitive to heat action. A very slight rise or fall in the hearth temperature affects the silicon content in the iron, and to secure regularity of working in hot-blast furnaces the sum

of Al_2O_3 and SiO_2 should not exceed 50 per cent.

It is easy to see that to work with such slags the heat reserve in the stoves must be such as to secure regular temperatures at the tuyeres. A variation of 100 deg. C there may readily convert a grey into a mottled or white iron, for the reasons above explained.

Influence of Flue Cinder.

This material being a slag descends into the boshes and possibly into the entrance of the hearth before it melts, and runs with high fluidity into the slag, mixing with it and greedily absorbing lime therefrom, whilst the ferrous oxide is reduced in contact with the coke, thus $Fe_2O_3 + 3C = 3CO + 3Fe$. The iron released is not carbonised like that which reaches the boshes from the other ores, and hence the tendency is to make a pig-iron of lower carbon content. If the flue cinder accidentally flows down locally on one side of the furnace, iron having a mixed or scattered fracture is likely to accrue. If the slags from the ore mixed with it are deficient in lime, scouring slags may be formed and run down the boshes, robbing silica and alumina from the lining and leading to short life of the furnace. Generally, however, the lime added to the charge forms a slag first with the ores, and this may be of a highly basic nature before the flue cinder (molten) runs into it and is absorbed by it. Under any circumstances the action of flue cinder tends to irregularity in product.

Sulphur, Manganese and Phosphorus in Slags.

The combined lime, manganous oxide and magnesia in normal slags averages 50 to 55 per cent. The saturation of slags with basic oxides CaO, MgO and MnO depend largely on the temperature under which they are formed. If that temperature is exceeded and there is available an excess of CaO or MgO, manganese is reduced from the slag. It is under such conditions that sulphur is also absorbed by the slag, the excess lime uniting to form CaS, which union is probably assisted by the dissociation of the MnO in the slag as manganese passes into the pig-iron. It is pretty certain that a basic lime slag will desulphurise iron the more efficiently in proportion as the MnO and FeO contents of the slag are reduced, in so far as the latter is in a fluid condition. When the fusion zone in a furnace is kept low down (as when using hot blast) the conditions for the production of low-sulphur iron are most favourable. It has been pointed out that reactions occur in the sulphur exchanges of the following order:—$CaO + MnS\ (FeS) \rightleftarrows CaS \times MnO\ (FeS)$. All blast-furnace slags are really acid in nature and the sum of SiO_2 and P_2O_5 therein exceeds 25 per cent., beyond which point dephosphorisation of the iron cannot occur (Campbell). Hence the phosphorus in the normal slags must all or nearly all pass into the pig-iron. The liquid condition is here also favourable to the slag dephosphorising action, as might be expected. The lower temperature of acid slags containing 35 per cent. to 45 per cent. of SiO_2 is favourable to the rapid passage of the phosphorus from the slag to the pig-iron.

Speed of Burden Descent.

A lean silicious ore demanding heavy lime and fuel complement passes through the furnace at a very different rate to rich ore with small flux additions and low fuel ratio, both being blown with a view to maximum output of iron. The iron smelted from a 35 per cent. Fe ore mixture fills the hearth at the rate of, say, about 3 in. per hour, whilst its slag rises at the rate of 12 in. per hour. In a rich ore mixture (55 per cent. Fe) the iron is smelted at the rate of, say, 4.5 in. per hour and the slag rises in the hearth at the rate of 9 in. per hour. The average thickness of the slag blanket during smelting is in the case of the 35 per cent. Fe ore 24 in., and in that of the 55 per cent. Fe ore 20½ in. In the first case the iron is subject to the influence of the slag for 12 hours, and in the latter eight hours, between tappings. The thickness of the slag blanket is least during the first and last few hours between two tappings, and it may be reasonably inferred that the quality of iron being produced varies, if during this period the blast volume and temperature remain constant, the more silicious iron being produced just at the commencement and towards the end of the periods between tappings.

TABLE III.

Characteristics of actions.	Analyses, etc.
1. Slow descent of burden. Small slag volume	Swedish charcoal iron.
Low blast temperatures. Rich ores used	Carbon 4.0 to 4.2%.
Silicious slags of low fusion temperatures	Silicon 1.0 to 2.0%.
Silica+Alumina=60% to 65%.	
2. Medium speed of burden descent ...	Hematite iron.
Rich ores. Small slag volume ...	Carbon 3.8 to 4.0%.
Hot blast 900 dg. to 1100 dg. F. ...	Silicon 1.5 to 2.0%.
Silica+Alumina=45% to 50%.	
3. High speed of burden descent ...	Cleveland iron.
Medium ores. Medium slag volume	Carbon 3.5 to 3.8%.
Hot blast 1000 dg. to 1100 dg. F. ...	Silicon 1.5 to 2.0%.
Silica+Alumina=50% to 55%. ...	Phos. 1.2 to 1.5%.
4. High speed of burden descent ...	Northampton iron.
Lean ores. Heavy slag percentage	Carbon 3.0 to 3.5%.
Hot blast 1100 dg. to 1300 dg. F. ...	Silicon 1.5 to 2.5%.
Silica+Alumina=45% to 50%... ...	Phos. 1.2 to 1.6%.
5. Medium speed of burden descent ...	Staffordshire iron.
Mixture of medium ores and flue cinder	Carbon 3.0 to 3.5%.
Hot blast 900 dg. to 1200 dg. F. ...	Silicon 1.5 to 2.5%.
Silica+Alumina=45% to 55%... ...	Phos. 0.8 to 1.0%.
Shows influence of flue cinder on reducing the total carbon content in the pig-iron.	

The carbon content in the pig-iron largely depends upon the time of contact between the ore and the coke during the travel of the burden through the furnace. It is also largely influenced by the intimacy between the reduced iron and the gangue, the lime, and the final slag. Representative analyses illustrating the above actions are shown in Table III.

REDUCTION IN THE COST OF PRODUCING RADIUM.—According to an announcement made recently by Mr. F. K. Lane, the United States Secretary of the Interior, the production of radium from Colorado carnotite ores by the Bureau of Mines, in connection with the National Radium Institute, has passed the experimental stage in its new process, and is now on a successful manufacturing basis He also declares that the Bureau of Mines is able to produce radium at a greatly decreased cost as compared with other processes. From information furnished by Dr. C. L. Parsons, who is in charge of the radium investigations of the Bureau, the cost of one gramme of radium metal produced in the form of bromide during March, April and May of last year was about £7,210. This includes the cost of ore, insurance, repairs, depreciation allowance for plant and equipment, cost of Bureau of Mines co-operation, and all expenses incident to the production of high-grade radium bromide. When it is considered that radium has been selling for £24,000 and £32,000 a gramme, it will be realised what the Bureau of Mines has accomplished.

American Practice in the Manufacture of 8-in. and 9.2-in. H.E. Shells.

In a recent issue of "The Iron Age," New York, Mr. C. A. Tupper, consulting engineer, of Chicago, describes the manufacture of shells of large calibre.

After remarking that lessons drawn from the European war have demonstrated, (1) the difficulty of providing facilities on short notice for the manufacture of heavy shells, and (2) the possibility of planning the work in such a way as to permit the use of practically the same equipment in turning out shells of different sizes within a reasonable range, the author goes on to say that a very good example of co-ordination in design and production is afforded by the British 8-in. and 9.2-in. shells. Furthermore, in the manufacture of projectiles of such sizes, as compared with smaller calibres, very considerable modifications are brought about by the increased diameters, lengths, capacities and weights, and also by the greater stresses set up in the material all along the line, from forging and machining to the discharge of the shells from field-pieces under actual service conditions.

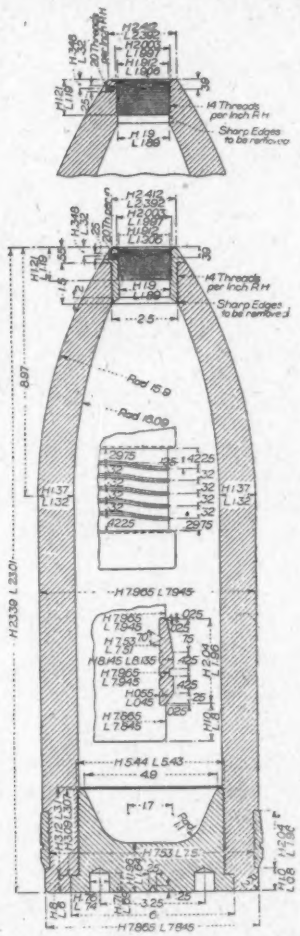


Fig. 1.—8-in. British Howitzer Shell, with Alternative Head.

Serrations of copper rifling band, shown in detail, are of 0.05 in. pitch and 0.032 in. deep.

The annexed cuts show the outline working drawings of high-explosive shells for 8-in. and 9.2-in. howitzers. On firing tests, as completed, these are each required to stand a charge which will give a chamber pressure of not less than 26,000 to 27,000 lbs. per sq. in., which conveys some idea of the materials and care needed in their production.

Open-hearth steel is commonly used for the body of the shell, and the original British specifications for these calibres provided exclusively for that made by the acid process. Requirements as to the forging billet are in general the same as those for 6-in. shells, except as stated later. Forging equipment which can be used for both sizes will include one or more units consisting of, say, a 1,500-ton vertical piercing press, a 1,000-ton vertical or horizontal drawing press, a large accumulator and the necessary pumps, surge tanks, operating valves and high-pressure piping—all designed for a working pressure of 3,000 lbs.

8-in. Shell.

After the forging has been delivered to the machine shop it is handled on very much the same lines as the smaller high-explosive shells described in the previous article. The first essential operation, apart from work to facilitate the setting and handling, is roughing off the base. Then, in the case of the 8-in. shell, gauging to approximately 23.5 in. (for a finished length based on 2.9 calibres but not exceeding 23.39 in.), the open end of the forging is trimmed. Roughing and finishing cuts on the exterior of the body leave a diameter for the cylindrical section of 7.955 in., with only 0.01 in. tolerance, against a length of 23.2 from the finished base edge, with 0.19 in. tolerance. The nose, which should be formed to approximate closely the contour in the drawing press, is machined so that it tapers from the diameter of the body cylinder to a maximum of 2.412 in. or minimum of 2.392 in. at the open end. The contour of the head, which must be concentric within 0.0375 in. of the true longitudinal axis of the body, is formed on a radius of 15.91 in., as shown by the drawing. This, it will be noted, is the equivalent of two calibres. One lathe, with turret tool blocks, will do all of the body turning on a single shell in something under an hour.

Rough and finish boring of the interior requires a powerful horizontal drill of the lathe type, using either single-point tools governed by a former or else formed tools. With sufficiently skilled toolmakers and machinists, the latter are preferable. For these operations 1½ to 2 hrs. must be allowed, depending upon the exact conditions of service. Finish boring brings the interior diameter of the cylindrical section to approximately 5.25 in., with tolerances governed by the finished outside diameter and by a maximum wall thickness of 1.37 in. or minimum of 1.32 in. From the bore mentioned the interior tapers on an arc radius of 18.05 in. to exactly 2.5 in. at the junction of the removable nose piece (or to 1.9 in. if the alternative integral threaded head is used). The total chamber capacity should approximate 362 cub. in.

With either type of head only one tommy hole has to be drilled and tapped and only one set-screw provided for, as contrasted with two for the 6-in. shell. This screw has a diameter of ¼ in. and a right-hand thread cut on the scale of 20 to the inch. The low position of the driving band, which is placed 0.8 to 1 in. above the base line, and the exceptional design of the hollowed-out plug or " baseplate " will be noted from the drawing. Depth of the recess to 3.92 in., with maxima and minima of the threaded and solid sections as shown, also indicates the degree of protection given against possible defects in the metal of the shell forging at the base from piping or other causes. A separate drop or power forging, with the grain of the metal lying across that in the wall of the shell, is used for the baseplate. Machining and threading of the latter can be economically done in an automatic machine. The bottom of the baseplate, exactly 6 in. in diameter, is broached for a ¼-in centreing indent and two ¾-in. holes for the screwing-in pins are drilled on a radius of 1.925 in. from the centre. The top of the baseplate has an outside diameter just sufficient for about 0.1 in. less than that of the cylindrical interior of the shell, to insure a close fit. After the baseplate has been cemented and screwed in, it is faced off smooth and the edge radius chamfered.

TABLE I.—*Weights of 8-in. Howitzer Shell.*

	Lbs.	Oz.	
Empty body, steel	173	0.5	
Driving band, copper	4	0	
Total empty, unpainted ...	177	0.5	Permissible overweight, 14 oz. underweight, 1 lb., 12 oz.
Paint	—	2.0	
Bursting charge	20	0.0	
Fuse No. 100, with gaine ...	2	13.5	
T tal filled	200	0	

The details show in section the design of the band seat, with the five ribs, each of which, cut on a 70-deg. angle, is given eight waves. Three chisel cuts are made across the waves, as usual, to permit escape of air when the copper band is being forced into place. The copper band is cut from tubing, pressed or swaged on, and turned as indicated in the details. A mean windage over the body of 0.045 in. is allowed for on each 8-in. or 9.2-in. shell. The maximum thickness of the copper on the former is 0.62 in., and it projects out 1.85 in. beyond the steel wall of the shell. Serrations are made 0.032 in. deep, 20 to the inch, over the upper section of 0.75 in.

9.2-in. Shell.

Having the above in mind for the 8-in. shell, it is easy to figure out the work necessary for the larger projectile. This 9.2-in. shell, apart from its larger dimensions, capacity and weight, differs from the 8-in. design chiefly in the shape of the baseplate and in its relatively greater capacity for explosive. In body calibre the shell is 9.155 in., plus or minus 0.01 in., and it has a length based on 2.91 calibres, which works out, in practice as a minimum of 26.63 in. and a maximum of 27.07 in. The thickness of the side walls, being practically identical with that of the 8-in. shell, allows for a relatively larger bore, so that the total chamber capacity is 614 cub. in., as compared with 362 cub. in. for the 8-in. shell. From a main diameter of 6.5 in., plus or minus 0.01 in., the shell interior tapers to 2.5 in. at the opening to the throat, which is the same as the corresponding measurement of the 8-in. shell. It will also be observed that while the dimensions of the nose and the length of the fuse bush necessarily exceed those of the 8-in. size, the shoulder of the fuse bush and the interior threaded part are identical with the corresponding section of the bush used on the 8-in. shell. Thus the fuses for the 8-in. and 9.2-in. shells are interchangeable. This is a feature of great importance, and one that could just as well be carried out for other calibres which can be grouped for purposes of manufacture and field service. The fuse specified for both of these shells is the British No. 100. The fuse bush was originally made only of brass, but mild steel can now be used. Only a single tommy hole and set-screw are required for the 9.2-in. shell, the same as for the 8-in.

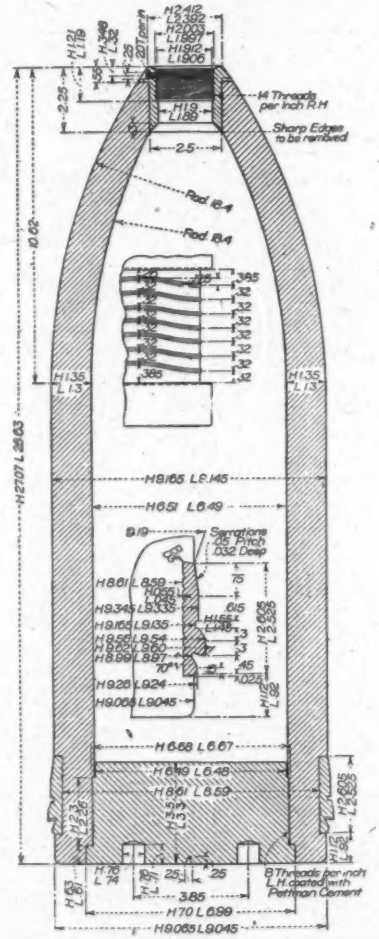


FIG. 2.—9.2-IN. BRITISH HOWITZER SHELL.

The baseplate of the 9.2-in. shell has a diameter of approximately 7 in. and a depth of 3.4 in., with 0.1 in. tolerance. Left-hand threads, 8 to the inch, are cut for holding this plate in. On its upper surface the baseplate is machined, as usual, to a diameter which will give it a snug fit, assumed to be 0.01 in. within that of the shell interior. In the bottom the holes for the screwing-in pins are drilled on exactly the same centres as for the 8-in. shell.

In cutting the band seat, seven ribs are made, with nine waves each, as illustrated. Copper is then pressed in and given the profile shown. A

feature differing from the 8-in. shells or those of smaller calibres is the projecting lower serrated section of the band, which gives an over-all diameter at this point of 9.61 in., plus or minus 0.01 in., as compared with only 9.155 to 9.165 in. for the steel cylinder of the body.

TABLE II.—*Weights of 9.2-in. Howitzer Shell.*

	Lbs.	Oz.	
Empty body, steel	244	7	
Driving band, copper	8	4	
	252	11	Permissible overweight. 10 oz. No underweight allowed.
Paint	—	2	
Bursting charge	34	5.5	
Fuse No. 100, with gaine ...	2	13.5	
	290	0	Plus or minus 4 oz., 10 dr

Testing.

Testing of 8-in. and 9.2-in. projectiles proceeds along identical lines, and it may be taken as a criterion for all heavy high-explosive field shells for calibres of 12 in. and under. Armour-piercing projectiles are, of course, in an entirely different class.

Before final acceptance of each lot, a certain number of shells, filled with sand or other suitable material, are required to be discharged from a field-gun on proving grounds where they can be recovered. The 8-in. shell shown is liable to "set up" with a chamber pressure calculated at 35,600 lbs. and the 9.2-in. shell at 2,400 lbs. less. A uniform test pressure of 26,000 lbs. has been fixed for both, and this must not be exceeded by more than 1,000 lbs.

With the firing conditions properly complied with by the artillery authorities making the test, specifications provide that "should the shells so fired set up or break up in the gun, or should the baseplate be found to have shifted or to have been incorrectly fitted, or should any portion of the driving band separate from the shell before the first graze or impact, the lot will be rejected." In case, however, it develops that the maximum chamber pressure of 27,000 lbs. allowed for was exceeded, a second proof is to be made, without expense to the manufacturer, before the lot is rejected. The pressure of this round, if not taken, will be assumed to be that of the last round fired with the same charge in which pressure was taken.

Field observation is made of the flight of the shell. If reported unsteady and found, on recovery, to be without its driving band or that the band has slipped or is loose on its seat, "then," say the instructions to inspectors, "the driving bands of a similar number of shells to those taken for firing proof may be cut out to ascertain whether they have been properly pressed down." If not, they are to be rejected. A lot once condemned, however, cannot be re-submitted unless the rejection was due wholly to the failure of the driving band or to rectifiable gauging defects. Such shells must also be given a small rejection mark, so that they can be readily identified when again tendered on the contract.

Basic specifications issued by the British War Department, which have been changed in the States as circumstances dictated, provide for a chemical analysis of the steel, apart from its iron, as follows:—

Percentages of Elements in Shell Steel.

Carbon	0.55	Sulphur	0.05
Nickel	0.50	Phosphorus...	0.05
Silicon	0.30	Copper	0.10
Manganese	0.40 to 1.00		

Any modification of those, including the introduction of additional hardening or toughening elements like chromium, vanadium, etc., must also be strictly a matter of agreement; but where permissible variations occur, trouble may be avoided by calling the inspector's attention to them promptly as analyses are reported by the works chemist.

Longitudinal tensile and compression tests are made on pieces cut from the walls of at least 1 per cent. of the shells made from every pouring, and two pieces for the same purpose are cut from the finished baseplate at right-angles to each other. An elastic limit of 38,000 lbs. and tensile strength of 70,000 to 98,000 lbs. are the minima that will pass inspection.

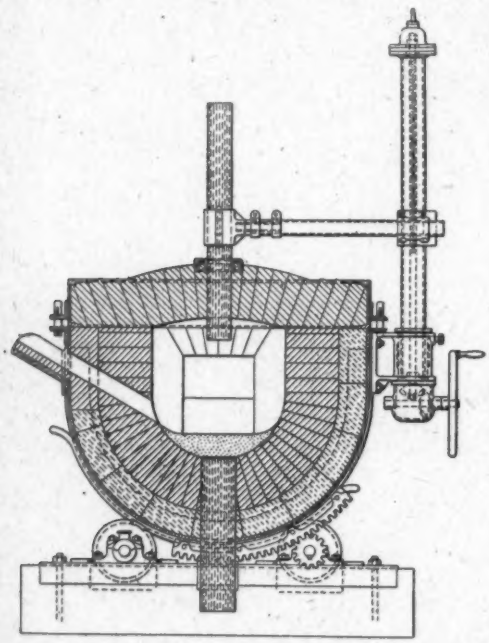
If a fuse bush made of brass is used, tests are made on pieces not less than 7 in. in length nor under 1 in. in diameter, with an elastic limit above 12,000 lbs. and tensile strength of 24,000 lbs. or more. Elongation required is 10 per cent. in 2 in. Not more than 0.1 per cent. of lead is permissible, and where the nose bush is liable to come in contact with the explosive it must be well nickel-plated or coated with "pure" tin. Such purity, however, seems to be open to doubt, for official specifications provide that "the pure tin or nickel used for coating must not contain more than 0.1 per cent. of lead," and the coating is to be continuous and satisfactory as regards adhesion in the opinion of the inspector.

MOULDING SAND TESTS.—A writer in "Stahl und Eisen," discussing the questions of moulding sands, suggests the following tests:—(1) Mix with water to determine how much is necessary to make a satisfactory form. (2) Tamp into an unglazed porcelain dish and rub the surface with a spatula—good sand should give a smooth and somewhat elastic surface. (3) Heat to 150 deg. C. A good sand will show little shrinkage and be hard and strong, while poor sand will disintegrate. (4) Drop water on the surface of the dried cake to test its porosity. This is determined by the rapidity with which the drop disappears. (5) Take 15 minutes to raise a sample of the sand in an electric furnace to a temperature of 1,350 deg. C., and hold at this temperature for 15 minutes. A good sand will remain in a hard cake and not be sintered. (6) Test with a drop of water to determine the relative porosity of the cake.

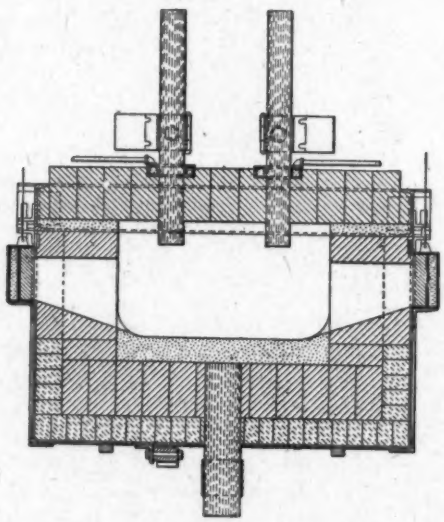
EFFICIENT LIGHTING.—It had been urged for a considerable time prior to August 4, 1914, by a few illuminating engineers that our lighting methods were, in the majority of cases, very wasteful, one principle of paramount importance being the necessity for controlling the direction in which a light source throws its beams. This principle is embodied in a special lamp which has been perfected at the Osram-Robertson Lamp Works, Hammersmith, and is known to the public as the Osram "Axial" type lamp. In appearance it differs from the standard Osram having a so-called pear-shaped bulb, in that it has a larger diameter but is more squat. By this means it is possible to arrange the filament, consisting of pure drawn tungsten wire wound into a helix of very small dimeter, into a comparatively small space so that the light is, to a great extent, thrown downwards instead of sideways as in the case of the ordinary tungsten lamp. The Osram "Axial" type lamp is not meant to replace the standard Osram lamp, although there are many positions where its use would be distinctly advantageous. By means of a conical opal reflector, which is made to fit closely to the upper half of the bulb, any rays of light which would otherwise be lost in the upward direction, are reflected downwards, thereby increasing the candle power in the direction required by nearly a hundred per cent. The new lamp is made by the General Electric Company, Limited, 67, Queen Victoria Street, London, E.C.

The Wile Electric Furnace.

A new type of arc electric furnace has been introduced into the American steel industry. From a statement recently issued by its inventor, Mr. R. S. Wile,* it appears that the three-phase type of construction has been adopted because the electric supply systems of the country generally are three-phase, and because furnaces using other than this entail expensive transformers and greater transforming losses in stepping from three- to two- or single-phase. The only other prominent arc furnaces using this current in the States are the Stassano and the Héroult. The Stassano has three horizontal electrodes, but is limited to a capacity of 5 tons; the Héroult has three electrodes inserted through the roof with no bottom electrode; while the Wile furnace has two top and one bottom electrodes.



Sections of the Wile Electric Furnace showing



Positions of Electrodes and Tilting Mechanism.

It is claimed that this latter connection has a number of advantages. In all steel-refining one of the most essential points is to free the steel of gases in order to make sound castings or ingots. In the furnace with the three top electrodes, or those entirely above the charge, it is necessary to superheat the steel or cause it to boil to free it of gases. This temperature is much higher than the pouring temperature, hence it is necessary to cool the steel before pouring. This causes undue wear upon the furnace refractories and a low load factor for the furnace. This is not the case in the three-phase furnace with the bottom electrodes, as the circulation of the steel is plainly visible and the superheating is unnecessary.

Again, it is often imperative that the furnace be started on cold stock. In loading the furnace the heavier pieces are placed on the bottom and the lighter and smaller pieces are placed on top so that the top presents a fairly smooth appearance, without ragged projections to cause unnecessary fluctuation in the line. This involves a little more time, but it saves it in the end by keeping the breaks from flying out so often. It also helps the load factor.

In starting a furnace with three top and no bottom electrodes it is necessary to burn a hole through the pile of steel clear to the bottom in order to form pools of metal to do away with violent fluctuations. These occur also in the furnace with the two top and one bottom electrodes, but to a smaller extent, owing partly to the absence of one top electrode lessening the number, but more particularly because of the melting of the steel on the bottom at the same time it is melting at the top, in that manner forming the pool more quickly and with fewer surges. In the Wile furnace the bottom electrode is made of graphite, but it stops short of the metal bath, the actual furnace bottom being made of a conducting compound of magnesite and tar, which causes no more trouble in operating than does the bottom in any furnace.

It is preferable, of course, to use molten materials. A large number of furnaces are thus operated, but it is often expedient to use cold stock where there is no open-hearth plant to furnish steel in the molten state. It is not prohibitive to melt it cold, but the demand on the source of power is greater and the installation more elaborate, owing to the greater amount of current needed if the same tonnage is required that is obtained from the furnace refining molten stock. It is not claimed that the current consumption in the Wile furnace is any less than in the furnace with three top or horizontal electrodes, as this factor depends largely upon furnace design and insulation; but it does enable the furnace to be worked with fewer abnormal variations of the load, and it can be more easily regulated by hand where there are only two electrodes

* "The Iron Age."

to manipulate, though automatic regulators are supplied to this furnace where desired, as they usually are. It uses less current than a single- or two-phase furnace in instances where these take the supply from a three-phase system, when the heat insulation of the furnace is not the sole factor but the losses in transforming enter as well.

Violent fluctuations of the load occur only when melting cold stock. All furnaces are uniformly quiet when running on molten material, and the number of furnaces refining molten steel is probably in excess of those starting with cold stock. The time consumed in refining the molten steel depends upon the impurities to be removed, though this is also true when cold material is used, but in this latter case the practices in different furnaces vary, and design also enters here. Some furnaces require a longer time than others, the variation of sizes and input of current being the chief factors. This is important when comparing furnaces.

Everybody interested is familiar with the possibilities of steel refining, but a few figures are offered to show the current consumption in a Wile furnace of 2 tons capacity, starting with cold scrap having the following fairly uniform analysis :—

	Cold scrap. Per cent.	Finished product. Per cent.
Sulphur	0.061	0.018
Phosphorus	0.04	0.024
Silicon...	0.09	0.110
Carbon	0.28	0.12
Manganese	0.31	0.31
Time of melting & refining		4 hrs. 20-min.
Kilowatt-hours per ton ...		868
Electrode consumption per ton		2a.

These figures are given not to prove superior practice, but as an idea of one operation.

Pickling of Castings

A writer in "The Mechanical World," discussing the pickling of iron and brass castings, says that the pickling tanks are made of cast iron, wood, or stone. When they are of cast iron they should be about 2 in. thick all over, as the acid gradually eats into the iron. If the tank is of wood it should be lead-lined. A very useful size is about 3 ft. square and 2 ft. deep. It should be set about 18 in. into the ground, and there should be a platform around it, slightly inclined towards the tank. The tank should be provided with a stout wooden grating, well pitched and dowelled together, having neither nails nor screws in it. This grating is placed at the bottom of the tank to allow the sand and sediment to sink to the bottom. The grating can also be used to lift the castings out of the tank, if they are not too heavy.

When it is necessary to clean large castings by this method, and the castings cannot be put into the tank, they should be placed on an inclined platform and the acid poured over them at intervals; this will loosen the sand on the casting, and it can afterwards be washed with potash solution and hot water to free the casting from the acid.

Of the several acids which can be used for pickling castings, one for cast iron may consist of sulphuric acid 1 part, water 5 parts; or hydrofluoric acid 1 part of 30 per cent. acid, and water 20 parts. These will clean a casting in about one hour; but should it be desirable to economise with the acid, and providing the castings are not required quickly, the following proportions can be used: Sulphuric acid 1 part, water 15 parts; or hydrofluoric acid 1 part of 30 per cent. acid, water 60 parts. With these solutions the castings can be left in all night. There is a difference in the working of these two acids, as the sulphuric acid works on the iron, while the hydrofluoric acid dissolves the sand.

Should the acids come in contact with the clothes or body they will cause nasty burns. When preparing the solutions the acid should always be poured into the water and not the water into the acid, the solution being stirred at intervals. These solutions work best when they are hot.

When the castings are taken from this solution they should be immersed in a hot solution of potash or soda, to neutralise the acid remaining on them, and from thence transferred to another tank containing hot water, and this, being used for the final washing, should be changed frequently. Hot water is used for the final washing.

The pickling or dipping of brass castings is not so much to clean them as to impart a colour to their surfaces. By dipping them a very bright surface is imparted. For brass castings it is desirable to use stone instead of cast-iron tanks. To obtain a bright surface on brass castings the solution should consist of 3 parts of sulphuric acid to 2 parts of nitric acid, adding about 1 oz. of common table salt to every 3 gals. of solution. The nitric acid is first placed into the stone tank, and the salt added. Then the solution should be well stirred with a stick, and the sulphuric acid slowly added while stirring. The above dip is a fairly smooth-working dip; but should it be desirable to have a more energetic dip, the two acids should be mixed in equal proportions. The castings for the bright dip must be thoroughly clean and free from all grease or oil, and they must be perfectly dry. If not they will have an uneven or mottled appearance. When the castings are taken out of the dip they are rinsed in boiling hot water, and then placed in sawdust to dry.

To obtain a golden-carrot colour on brass castings the following dip should be used: Sulphuric acid 2 gals., nitric acid 1 gal., muriatic acid ½ to 1 oz. The castings should be perfectly clean. First they are dipped in cold water, then into the dip; they are then rinsed in boiling hot water and placed in sawdust to dry. The action of acids on brass castings is fairly rapid.

HIGH-SPEED STEEL SCRAP.—Arrangements have been made by the Ministry of Munitions whereby the makers of high-speed steel will take back all scrap, short ends, etc., at uniform prices. The prices which have been fixed are:—5d. per lb. for turnings, and 6d. per lb. for bar ends, delivered at the steel works. All material of this kind should be returned as far as possible to the manufacturer who supplied the original steel. In cases where this is not possible, owing to supplies being obtained from a number of manufacturers, the scrap should be returned in proportion to the quantity of steel which was orginally received. The scrap must be packed in convenient-sized barrels, or other suitable cases, and should be free from all foreign substance, and particularly other kinds of steel. Turnings should be returned as soon as a reasonable quantity can be got together, and not kept until rusted solid; such scrap is practically worthless. Under the regulations published in the "London Gazette," dated March 3, as 30 B. of the Defence of the Realm Regulations, it is illegal to dispose of high-speed steel through any but authorised channels, and users are, therefore, advised that the above arrangements should be carried out in every case.

THE CANADIAN NICKEL SITUATION. — The Canadian Government has issued an Order-in-Council prohibiting the export of nickel from Canada save to British possessions, but provision has been made to allow the International Nickel Company to get all it requires from its mines in Canada. The Company has announced its intention to begin the erection of its Canadian refinery immediately.

British Foundrymen's Association.

BIRMINGHAM BRANCH.

The Birmingham Branch of the British Foundrymen's Association held its concluding meeting of the Session on March 25, Mr. D. Dalrymple (President) in the chair.

Annual Report.

The first business was that of the annual meeting for the election of officers. The Branch annual report stated that three of the Branch members have been or are still on the fighting front. Captain P. S. Bayliss (Wolverhampton) is serving with a South Staffordshire regiment, Mr. F. Mather is with a signal company of the Royal Engineers, and Quartermaster-Sergeant William Boyne was with a Highland regiment in France when, on April 25, 1915, he sustained severe wounds and has suffered the loss of the greater part of his right leg. The members of the Association resident in Coventry desire the formation of a branch either in Coventry itself or in a place more accessible to them than in Birmingham, and the Birmingham Branch will be ready to further in every possible way the realisation of the wish whenever the opportune moment arrives. The membership of the Branch is 12 Members, 78 Associate Members and 50 Associates. The Diploma of the Association for the Birmingham Branch was awarded to Mr. H. L. Reason for his paper on "Copper Alloys."

The report was adopted and the following officers for the coming year were unanimously elected:—President: Mr. J. Shaw (Dudley); Vice-presidents: Messrs. I. I. Howell and A. Harley; Hon. Secretary: Mr. C. Grindlay; Auditor: Mr. C. Mace; Branch Council: Messrs. R. Buchanan, J. Bullock, D. Dalrymple, C. Heggie, F. Holberry, H. Mather, C. B. Pugh, H. L. Reason, C. B. Roe, F. E. Robinson, J. H. Toy, H. Winterton, and E. N. Wright, and Captain P. S. Bayliss. The Vice-presidents were appointed, with the President, as representatives on the Central Council.

Government Work—Appeal for More Efficient Guidance.

Mr. R. Buchanan then gave an address, illustrated by samples, on "Moulding and Casting Howitzer Bombs." The discussion turned largely upon some allusions made by Mr. Buchanan to the absence of definite guidance, especially in the early stages of the war, from Government officials as to what was required of the foundryman.

Mr. J. Shaw said the castings dealt with had given some trouble in various shops at first. He endorsed all that Mr. Buchanan had said about the future economic struggle. It behoved us to be ready for this, and no one with any intimate knowledge of Germany's shops, where everything in the way of labour-saving appliances and good organisation prevailed, thought the struggle would be a light one. With regard to the two positions shown for making bombs, neither of the vertical methods, as the lecturer stated, was equal to that shown in December last by Mr. J. G. Robinson. As for those shown moulded two at a time in the horizontal position, he knew two firms who were making the castings successfully that way, but great care had to be taken that the tube or core iron was strong enough to resist the lift at each end. The inspectors seemed to have so much to do that the founder had to wait weeks to get the sample casting inspected, so that one had either to stop the work or to go on and take the risk of rejection, whilst all the time the authorities at headquarters were pressing for delivery.

Mr. A. Bayliss said that he would like to assure the members that the Government had a very large board of advisers, all practical men. Manufacturers should distinguish between examiners and inspectors, the two offices being quite distinct and very different. There were only a few inspectors for the Midlands, comprising five counties, whilst for the same district there was a large number of examiners. There was a certain amount of examination which could be done by an ex-tailor or ex-butcher, but the inspector was a man who did know the business, and in some cases possessed a degree, and should not be classed with the examiner in any way.

Mr. F. E. Shearman said that hundreds of firms in this country had lost large sums of money through not knowing exactly what was wanted. If the Government had such a magnificent Board, why could not manufacturers have been given more definite guidance, for instance with regard to castings for bombs and for grenades? There was one small casting, samples of which were rejected for an error of 3/1000 in., but the pressure of one's fingers would make that difference. He heard of an inspector who, when sent to a malleable iron foundry, had to confess that he had never before been in such a foundry. The speaker expressed the hope that manufacturers and the country generally would learn much from the troubles that had been experienced since the war broke out, and that in all departments of the national life they would get more definite guidance from those who were supposed to lead.

Mr. L. Whitehouse, whilst agreeing that manufacturers had been placed in great difficulties, thought that they ought to take into consideration the fact that the country at the outset was not organised for war. Bearing this in mind and the fact that the war had been one on an unprecedented scale, it was not surprising that there should have been some disorganisation at first, though he thought that we had done wonderfully well considering the conditions under which we had to start.

Mr. Buchanan, in the course of his reply, said that he had not referred to German organisation because of any general admiration of the Germans; but there was no reason why we should not, for our own advantage, copy the Germans in some of their good points. One of those points was organisation; technical education was another, and, he thought he might add, elementary education. If we did not carry out the lesson of the war on these points it would be a great misfortune to our country. We could not succeed by simply believing that we were the finest people on the earth. That belief could only be good for us if we lived up to it. The war was not going to end with the proclamation of peace. There would follow an economic war which would be fought with a desperation never before known, and we should have to deal with problems of a most serious and difficult character. That was why he had emphasised the importance of organisation and preparation on the part of all who were concerned in the country's industries. With regard to inspection, one thing from which manufacturers had suffered was that they were allowed to make many hundreds of articles for the Government before the inspector

put his foot on the ground, so they were not able to know that what they were doing was right or wrong. People, in a patriotic spirit, had pushed ahead, only to suffer loss in consequence. That, he considered, was gross mismanagement. To a man who mentioned to him that he had a chance of making certain articles for the Government, his advice was, "Go ahead and make fifty, and then do not stir a foot farther till you are assured they are right." A great many people would have been saved from mistakes and losses if they had acted in that way. Referring to inspectors and examiners, there was a difference no doubt between the two classes of officials, and there were in each class some good and some bad. But even the most learned professor might not be able to tell them how to deal with the difficulties presented by castings such as those he had dealt with. It was satisfactory to know that all those experts had been called in to deal with general metallurgical questions, but more guidance was also wanted from practical men. He agreed that we might be proud of what we had done in the circumstances, but we must not rest upon our laurels.

A hearty vote of thanks to Mr. Buchanan concluded the meeting.

SCOTTISH BRANCH.

The annual meeting of the Scottish Branch of the British Foundrymen's Association was held on March 25. Mr. M. Riddell (the President) occupied the chair.

The Council's report stated that the Scottish Branch still held its own. The number of members at present is 189, which compared with last year shows a decrease of 17. Owing to the difficulty of obtaining suitable meeting places, the idea of holding meetings in other centres than Glasgow has had to be abandoned for the present.

The following officers for the forthcoming session were elected:—President, Mr. Matthew Riddell; Vice-Presidents, Mr. R. R. McGowan and Mr. William Bell; Hon. Treasurer, Mr. John Logan (Stevenston); Hon. Secretary, Mr. John Macfarlane, 3, Sharrocks Street, Ibrox, Glasgow. Council: Messrs. D. McQueen (Falkirk), H. Williamson (Dalmuir), H. Wilson (Coatbridge), Thomas Bell (Barhead), W. J. Boyle (Falkirk), R. B. Robinson (Shettleston), M. Mackay (Paisley), A. Naylor (Shettleston), R. Robertson (Falkirk).

Combustion in the Cupola.

At the conclusion of the business meeting, the PRESIDENT introduced a discussion on "Combustion in the Cupola." He stated that the completeness of combustion and the rate of burning in the cupola depended on the supply of air and how it was introduced. It should be the aim when designing a cupola to see that the tuyeres and auxiliary tuyeres were so arranged as to obtain as nearly as possible absolute combustion. To obtain complete combustion the whole of the carbon of the coke should burn to carbon dioxide (CO_2). Carbon dioxide or carbonic acid was a colourless and invisible gas. If the combustion of the carbon or coke were not complete it passed off in the form of carbon monoxide (CO). Carbon monoxide or carbonic oxide was produced when carbon was burned with a limited supply of oxygen. It was the main source of heat when producer gas was burned, and the main agent by which oxide of iron was "reduced" in the blast furnace. It was a poisonous gas when inhaled.

One pound of pure carbon burned to CO_2 produced 14,544 B.T.U. of heat (one B.T.U. being the amount of heat required to raise 1 lb. of water 1 deg. Fahr., the water being at 39 deg. Fahr.).

One pound of carbon burned to CO only generated 4,320 B.T.U. If carbon monoxide were mixed with a sufficient amount of air, it produced carbon dioxide (CO_2) and evolved 10,220 B.T.U.

It was the aim, therefore, of every foundryman to produce as much CO_2 from the coke as possible, and it was with this object in view that the lecturer advocated the introduction of small auxiliary tuyeres immediately above the melting zone, not less than 2 ft. 6 in. nor more than 4 ft. above the top of the tuyeres. The total area of these should be about $\frac{1}{4}$th the area of the main tuyeres and each about 2 in. in diameter. Care should be taken not to set up another zone of fusion, nor should the auxiliary tuyeres be too high from the main tuyeres, because if placed too high they might only cool the gases.

In cupolas without auxiliary tuyeres a proportion of the carbon of the coke left the melting zone in the form of CO. It was possible to transfer this into CO_2 by bringing it into contact with a necessary supply of air, through the auxiliary tuyeres.

The lecturer stated that cupolas in a very important foundry in the West of Scotland were built on this principle and gave a continuous average output of 16 of iron to 1 of coke, the bed charge being included.

An interesting discussion followed, and the meeting closed with a vote of thanks to the President for introducing the subject.

NEWCASTLE-ON-TYNE BRANCH.

The Newcastle and District Branch of the British Foundrymen's Association received an official visit from the General President of the Association, Mr. W. Mayer (of Dumbarton), on March 25, 1916. Mr. Mayer was accorded a typical Tyneside welcome, which was particularly appropriate in this instance from the fact that the President is himself a Tynesider. The Branch-President (Mr. M. Gallon), who took the chair, said they welcomed Mr. Mayer with particular pleasure, for he had spent the best part of his life on Tyneside. He (Mr. Mayer) had proved that there was no Royal road to success; by hard work, perseverance and quiet study he had shown to what a man could attain.

MR. MAYER gave a delightfully reminiscent speech of his early associations with Tyneside. He was glad that the Association had taken root and had shown such good progress since its inception. There was, of course, yet much to be done for the foundry trade. He appealed to them to do all they could to forward the interests of the trade, which was at the base of engineering. The beams of education which they had scattered had begun to revolutionise the industry. The metallurgical chemist was a modern innovation in the foundry, and he was certainly a very important one. At the same time it was a mistake to suppose that the metallurgical chemist should be the foundry manager. Foremen, managers and chargemen alike should be persuaded that it was their duty to become members of the Association. Membership was the best investment that they could possibly get.

Referring to the pioneers of the industry, Mr. Mayer said they were all aware of the position which it had taken on Tyneside, especially in connection with dry-sand moulding for the making of all kinds of heavy engine work. When he commenced his life on Tyneside that system was just being brought into vogue, and the man to whom they were chiefly indebted for the great part taken in that pioneer work was John Surtees. He deserved great credit

for the work he accomplished, and he (the speaker) was disappointed to find that no memorial existed on Tyneside to perpetuate his memory and work in connection with the establishment of dry-sand moulding. If they undertook to raise a memorial of some kind—a memorial over his grave in Jesmond Cemetery, Newcastle, or a bust in one of the technical colleges—they would find him a liberal supporter. (Applause.)

Female Labour in the Foundry.

The PRESIDENT next referred to the subject of female labour in the foundry, and said this was becoming an acute question. He understood that some of the firms down in the lower reaches of the Tyne had already moved in the matter, and he understood the innovation was working very well.

MR. WEIR (South Shields) said that at his foundry female labour was now an established fact. It had been rendered necessary because 75 per cent. of his men had joined the colours. The Government wanted the work turned out, and consequently they had to resort to female labour. There were now 50 women working in the foundry, and so far they had had no reason to complain of their work. An endeavour was made to give preference to women whose husbands had been killed in the war and to those who had families dependent upon them. They had proved that they were game enough to tackle any job, no matter how arduous. He believed women would play a prominent part in the solution of trade problems when the war was finished. He had found women far more conscientious workers than men.

MR. IRELAND also added his experience, and said one woman he knew had worked as a slinger and could use a hammer like a man. Another had asked to be allowed to work the electric crane. "They are all doing splendidly," was his verdict.

The PRESIDENT said it was satisfactory to know that the experiment had proved so successful.

MR. CARMICHAEL (South Shields) said that it was a case of necessity. In his foundry they had only one labourer left, and they had been obliged to employ women. They were now overcoming most of their difficulties.

MR. DAVISON (Hartlepool) expressed surprise at the remarks which had been made with regard to the employment of women in the foundry. He thought it was lowering womanhood very much indeed by the way in which they were utilising female labour in the foundry. They were putting them to the worst jobs. If there was need for women at all in the foundry they should be put to core work, which girls could be trained to do quicker than boys. At the same time, he recognised that there was a great scarcity of labour.

MR. WALLIS (Wallsend) said the last speaker had missed the point. He agreed that the foundry was the last place in the world where females should be employed, but it was a case of absolute necessity at the present time. The making of cores was ideal work for a woman, but that was already done, and it was in regard to the ordinary labourer's work where they were short. Output would win the war, and they must keep up the output, even by employing women in the foundry. He associated himself cordially with the remarks of the President with reference to John Surtees, through whose influence it was that he was introduced to the engineering world on Tyneside. It was only fit and proper that such a pioneer of the industry should have some permanent memorial to his name and work in the district which was so much indebted to his ability and genius.

Votes of thanks closed the proceedings.

LONDON BRANCH.

A meeting of the London Branch of the British Foundrymen's Association was held on April 14, Mr. A. Willis in the chair. Mr. W. Mayer (President of the Association) was present in his official capacity and gave a brief but interesting address, in which he expressed his appreciation of the honour of holding the position of President of the Association, which represented such an important branch of engineering. Founding was, he remarked, the basis trade of the engineering industry, and was also the pioneer of most industrial progress. Since founding had come into commercial being as a practical possibility the development of the world's industries had progressed by leaps and bounds.

Moulding, he continued, was a skilled trade—in short, a fine art. But its difficulties did not seem to be understood by other branches of industry. The founder in his work worked to get the best results every time, but there were many things that affected the final results, and which were beyond control. As an example of the service which the founder rendered, he recalled that when he sailed from the old quay at Newcastle-on-Tyne for London, in 1869, the quay was a very dilapidated structure. The existing quay was constructed on cast-iron sinking cylinders, many hundreds of which he had himself made.

Touching the work of the British Foundrymen's Association, it had had a far-reaching effect in educating foundrymen in matters concerned with the trade, both scientific and practical. That work, he thought, could not have been done by any other body; but a greater and wider field still existed, and the coming practical men, on whom the future of the trade depended, should be brought in. Master founders, also, should be urged to join the Association, for its work benefited them very greatly, and they could not make a better investment than the payment of the fees for membership for their foremen and men.

Mr. Mayer next referred to the generally-held opinion of moulding as a craft, and insisted on the dignity of such an important calling. Every endeavour should be made to uphold that dignity and raise the standard of youths who were attracted to the trade. It had been found that a material advance in wages to the boys—wages more in keeping with the skill required—did much to get a better class of lads. The Secretary of the London Branch had formulated a very ambitious scheme in connection with the scientific and educational advancement of the trade, and that scheme would come up for consideration later when industrial conditions allowed; but it would require considerable financial support.

The speaker next referred to his own term of office, now soon to expire, and stated that as he had not incurred the same expense on behalf of the Association (owing to the usual annual conference and social functions not being held during the war) as had his predecessors, he proposed to present to the Association a Chain of Office to be worn by future Presidents. He hoped to have the pleasure of placing it round the neck of his successor at the next Annual Meeting. Perhaps the time would come when some one interested in the British Foundrymen's Association would be able and willing to give it a Charter.

At the conclusion of his address a very cordial vote of thanks was accorded to Mr. Mayer, and the remainder of the evening was spent in social intercourse and song.

Foundry Cost Keeping.

British Foundrymen's Association.

At the March meeting of the Lancashire Branch of the British Foundrymen's Association, Mr. H. Sherburn in the chair, a Paper was read by Mr. F. Penlington on "Foundry Costs and Cost Keeping," and a discussion opened which was ultimately adjourned to the next meeting. The President of the Association, Mr. W. Mayer, of Dumbarton, was a welcome visitor.

Mr. Penlington, after some preliminary observations on the absolute necessity of cost keeping on a well-devised and carefully formulated basis, if success was to be attained, proceeded to give a scheme applicable to a foundry capable of turning out from 12 to 18 tons castings per week. His estimates of the disbursements were as follow:—Rent, £100 a year; cost of fixed plant purchased from a previous tenant, £300, though it was questionable if it could be bought for the money under ordinary circumstances; interest, £5 per cent., £15; depreciation, 10 per cent., £30; insurance premiums on employers' liability, say £15; other minor details or charges, £20 a year; gas (if used for power and lighting), water rates, taxes, £150 a year; moulding machines and all other necessary items of loose plant, £250; which at 5 per cent. interest and 10 per cent. depreciation would be £37 10s. All these were fixed overhead charges. Then there were the establishment charges, manager's or employer's salary, secretary or cashier, clerk, advertising charges, haulage, etc., for which he allowed £854 per annum; stores account (not raw material), £208; miscellaneous items, shovels, etc., after they had got their first equipment, £82; replaces and repairs, £88 10s. Those were variable charges. The total amount of the above-named expenditure came to £1,585 a year, or £30 10s. a week, which had to be provided by the foundry. Then the incidental charges, including foundry labour, moulding, core making and fettling, would be roughly £20 a week. Then there were the items for raw material, pig-iron £3 per ton, scrap £2 10s. per ton, coke £1 7s. per ton; which would work out 7 tons of pig-iron, £21; 5 tons of scrap, £12 10s.; coke, 1 ton, £1 7s.; loss on melting 15 tons, 5 per cent., £2 1s. 9d.; 12 hours engine and blower (1s. per hour), 12s.; furnace men and labourers, £3 18s.; making altogether, £41 9s. 3d. Having given a number of detailed calculations regarding wages, and the basis on which they had to be made, he remarked that it all went to prove that the cost of labour was greater than many of them would have imagined, which again showed the necessity of keeping accurate accounts of each individual item of expenditure under a given formula. The result was, that the total cost of production came to 10s. per cwt. of castings, and if the selling price was the same, 10s. per cwt., then though the firm would not lose on the job, neither would they make any profit. The establishment charges would vary from time to time, according as stores were checked, the best results obtained from the tools, and all due economy exercised. The least that could be said was that if cost keeping was properly looked after, complaints would cease about the department being unprofitable, changes in the personnel of the establishment would be fewer, and the foundry foreman would take his proper place with other foremen, while the foundry itself would be lifted to a higher plane than it had ever held before. (Applause.)

Mr. Mayer confessed that the Paper had rather staggered him, but Mr. Penlington had certainly proved what an important factor the plant of a foundry was. He (the speaker) was not there, however, to lecture to the members, but to fraternise with them. With regard to the Association, though they had made considerable progress, it was far from being complete; all the same, the foundryman was beginning to occupy that position which was his by right. As President, it was his duty to carry on the traditions of the Association loyally, and he intended to try and do so. The Association could only achieve the objects for which it was founded through the Branches, who at their meetings should discuss questions of general interest to the members, and in other ways promote the well-being of the whole body. It was part of their duty to disseminate new ideas, and suggest improvements in present methods; in short, to show how things might, and should be, done better than they were done now. For himself, he never went into a foundry without learning something, seeing some improvement in one thing or another, on his own way of doing things. Then they should strive to obtain lectures from men of practical experience, and members should lose no opportunity of attending them. He especially appealed to foundry masters to join their local Branches, in their own interests as much as in the interests of the men. The better the instruction given to the employés, the more was the benefit accruing to the employer. Indeed, in fairness to their men, and in justice to themselves, the employers ought to belong to the Association.

Mr. W. H. Sherburn asked the reader of the Paper whether he had in mind a foundry doing its own work and selling the production, or part of large establishments? Mr. Penlington: A separate foundry.

Mr. Walker said that in his opinion £854 a year for establishment charges was rather heavy for a 12 or 15 ton per week shop, and the same remark would apply to the sum total, £1,590.

Mr. Key remarked that there was plenty of room for criticism in the Paper, and there was a good deal on the board with which he was not inclined to agree. The figures were bound to be based on a certain class of work, and as the work varied the cost would vary. Some of the items did not coincide with his own experience at all, in the case of scrap, for example. Mr. Penlington stated that the products of the foundry made more profit proportionately than any other branch of the trade; that might be his experience in a particular class of work, but he (the speaker) had found that the margin of profit, even if they looked after things as they should do, and paid attention to the work, was very little compared with some other branches. A great fault on the part of many responsible managers of businesses was that they did not take into their confidence the heads of departments, foundry managers, or foremen. If they would only do that, and let them have a free hand in the matter of buying, they would know better where they stood. Time keeping and cost keeping were quite right for those who had the necessary time, but such men were in a very enviable position. In point of fact, no one could substantiate or contradict the statements made by the author without knowing all the details, including the position of the foundry. All the same, he had thoroughly appreciated the Paper.

The hour for closing the proceedings having arrived, it was decided to adjourn the discussion.

At the April meeting, Mr. Penlington recapitu-

lated the figures he had previously given as to the cost of running a foundry such as he described.

Mr. R. W. Kenyon said he had listened with much interest to the Paper, because for over forty years he had been keeping a close account of everything that went on in their works, being satisfied that no man could conduct a business successfully unless he paid most careful attention to his charges, comparing them quarter by quarter and year by year. When he was works manager, he was always trying to instil into the foremen the fact that if a man was off for a day the firm lost more than a day's wages, and Mr. Penlington's figures he considered fully bore out his contention. He did not accept everything that had been put down on the blackboard that afternoon, because figures must necessarily vary; for example, the overhead charge or charges might be quite right in the case of one shop, and too little in the case of another. No foundry manager was fit for his place if he could not work out the cost of a job. The point for each one to consider was: Can I make this at this cost, because if I cannot I do not want the job? It was really astonishing how many mouths there were to feed when they came to work out the cost of a particular job. When they were making a standard article all the year round, of course the cost was more equable than in those foundries in which jobs varied.

Mr. Bickerton agreed that the importance of overhead charges was not realised by many foremen who did not take into account the cost of melting, etc.

Mr. Penlington said the figures he had given were not the figures of any particular foundry, but such as he had gathered from various sources. At the same time they were fairly accurate, and if they went through them he thought they would agree they were based on a moderate scale.

A hearty vote of thanks was accorded to Mr. Penlington for his Paper.

Correspondence.

Quick Production of Carbon Steels.

To the Editor of The Foundry Trade Journal.

Sir,—I read with interest the remarks in your March issue on "Quick Production of Carbon Steels," by Mr. J. Peers. The latter states that a 3-lb. bag of crushed anthracite coal added to 3 tons of steel from a Tropenas converter will add 0.10 per cent. of carbon.

I have used the "Darby" process of recarburising on and off for the last 20 years and have found the results to be very variable. About one-half of the anthracite added is absorbed by the steel, the actual quantity depending somewhat on the temperature, a very hot heat taking up more than a cold one.

168 lbs. of pig-iron, containing 4 per cent. carbon, adds 0.10 per cent. to 3 tons of steel; 168 lbs. of this pig-iron contains over 6½ lbs. of carbon. Taking anthracite at 90 per cent. C., and assuming the steel absorbed all that was added, 7¼ lbs. approx. would have to be used to add 0.10 per cent. C. to the weight referred to. According to my method of calculating, 3 lbs. will add 0.02 per cent. C.

I should like to know whether the writer gets the results he claims regularly in practice.

Yours, etc.,

G. Roberts.

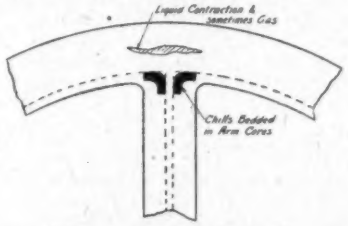
Ecclesall, Sheffield,
March 28, 1916.

Query.

Contraction Cavities in Spur-Wheel Blanks.

I am having trouble with certain Government work which is really very simple from a moulding point of view, namely, spur-wheel blanks. The teeth of these are cut, of course, after they are turned and I find in many of them liquid contraction or gas holes at the rim where the arms join. (These are mostly of H section.) To get over contraction I introduced "chills," or denseners, at the corners of the arms, and found that for a while I quite got over it at that point, but it seemed to move it midway between the arms.

The larger wheels (some exceed 1 ton) are moulded in the floor and the arms cored out in the



usual way. The mould is made of dry sand and dried in the floor; the smaller ones are taken to the oven and dried, cast from the boss, with four risers on the rims. The wheels generally have six arms. A feeding rod is placed in the boss, and also in the risers. The metal we use taps out at:—Carbon, 3.40; silicon, 1.9 to 2.5; sulphur, 0.6; manganese, 0.6 to 0.8; phosphorus, 0.80 to 1.2.

I have tried greensand also, but the percentage of wasters is about the same. I would be pleased to have a suggestion for a solution of the difficulty. —"T. W. S."

ITALIAN ELECTRICAL FURNACES. — The "Metallurgia Italiana" gives the following list of electric furnace and electro-chemical works in the districts of Milan and Brescia:—

Name and headquarters.	Capital.	Product.	Works situation.
	£		
Soc. Anon. Ferriere di Voltri, Voltri.	380,000	Ferro-silicon and ferro-alloys and calcium carbide	Darfo.
Ind. Elettrochim. Battistoni e Rotelli, Venice.	—	Calcium carbide, barium salts and sulphite of soda	S. Giovanni Lupatoto Ardenno.
Soc. Anon. Elettrochim. Dott. Rossi, Milan.	120,000	Nitric acid, nitrates, chlorates, etc.	Legnano.
Soc. Anon. Elettrica ed Elettrochim. del Caffaro, Milan.	240,000	Caustic soda, calcium chloride, etc.	Brescia.
Soc. Anon. Fonderia Milanese d'acciaio, Milan.	120,000	Steel.	Milan.
Soc. Anon. Alti forni, fonder. acc. e ferr. G. A. Gregorini, Lovere	240,000	Steel.	Castro (Lovere).
Soc. Anon. Tubi Mannesmann, Dalmine.	400,000	Steel.	Dalmine.
Soc. Anon. Fond. Ambrogio Necchi, Pavia.	200,000	Steel.	Pavia.
Soc. Anon. Acciaierie Danieli & C. Milan.	12,000	Steel.	Brescia.

At each of the five works with electric furnaces producing steel scrap iron is the raw material used. The total of furnaces in the five plants is thirteen, of which six are recorded as working continuously.

Design for a Moulding Machine.

By D. Watson.

In placing the following suggestion for a moulding machine before foundrymen, the writer would like to draw their attention to the possibilities of such a machine. It is designed for moulding roof gutters, such as those used for weaving sheds, which are made in sufficient numbers to warrant a machine specially for that purpose, provided, of course, that it would improve on the present system of hand moulding. The present method is to bed a long, iron skeleton pattern in a box part, and ram to the joint; then the inside is vented and strickled out, boards are placed in forming the thickness on the bottom of the gutter, the joint is made and the top part rammed up. Usually the top works in hinges, and only requires swinging back. The pattern is then drawn out. There are several cross pieces which strengthen the pattern, and these have to be stopped off and cores set at each end for the flanges. The moulder generally has to finish every part of the mould, as the pattern often breaks the mould when drawing. The time occupied to make the mould for one casting is about ten hours for one moulder and one apprentice, and for about five hours a labourer is with them.

When the size of the casting is taken into consideration it is quite evident they are being produced cheaply; but the writer thinks the machine would produce a better and cheaper casting, for it is well known that machine-rammed moulds are much more even than hand-rammed, and therefore the surface of the casting would be even, the edges sharper, and the casting of a better appearance generally. The time for making would depend on the speed of the machine and the rate at which sand could be supplied.

With the machine running at a slow speed and two men filling sand through the hopper, a 24-ft. length should be complete in about 30 minutes, allowing about 45 minutes to square the ends, set the flange cores and make the impressions of brackets. Under the present system, the moulder, apprentice and labourer would be five to six hours completing the same amount of work. The setting of the top plates and getting ready to cast would compare favourably with the ramming of a sand cope, finishing and cramping down.

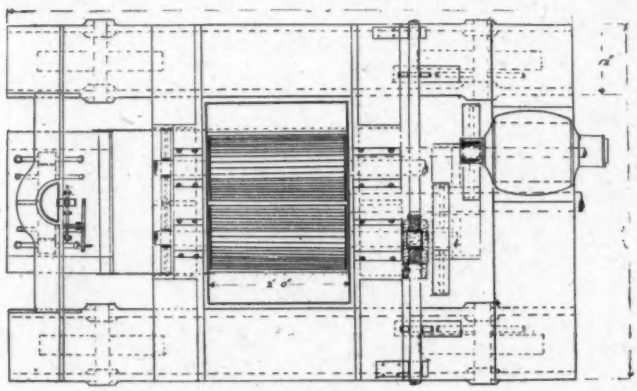


Fig. 1.—Plan.

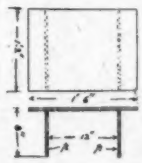


Fig. 4.—Pattern.

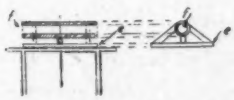


Fig. 5.—Section Holding Pattern.

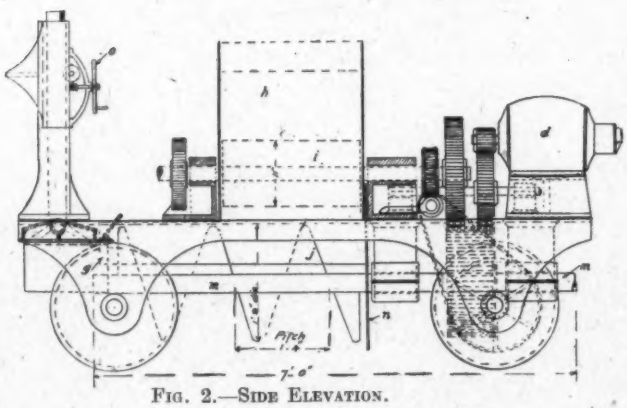


Fig. 2.—Side Elevation.

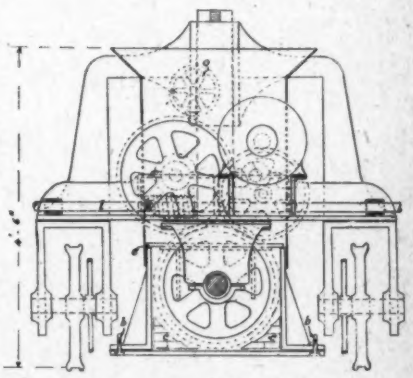


Fig. 3.—End Elevation.

Description of Machine.

Figs. 1, 2 and 3 show the plan, side view and end view, of a machine designed to travel on rails set parallel with the moulding boxes. Fig. 6 shows the bottom and side plates for building up the moulding boxes, which are 26 ft. long. Two bottom plates are set in the floor with pins through the holes (*a*, Fig. 6); then the side plates are placed on and secured with cotters (*b*, Fig. 3). Bricks can be laid in the bottom to fill the corners at *c*, *c*, Fig. 3; these should run the length of the box. The machine operates over the top of the moulding box and is driven by an electric motor (*d*, Fig. 2). The casting to be made (Fig. 7) is 24 ft. long, 18 in.

wide, and with a 12-in. gutter way and from 8 in. to 12 in. deep. These castings often vary in length, but it would not be necessary to set the machine to a given point so long as sufficient length of the mould could be completed to make the desired casting.

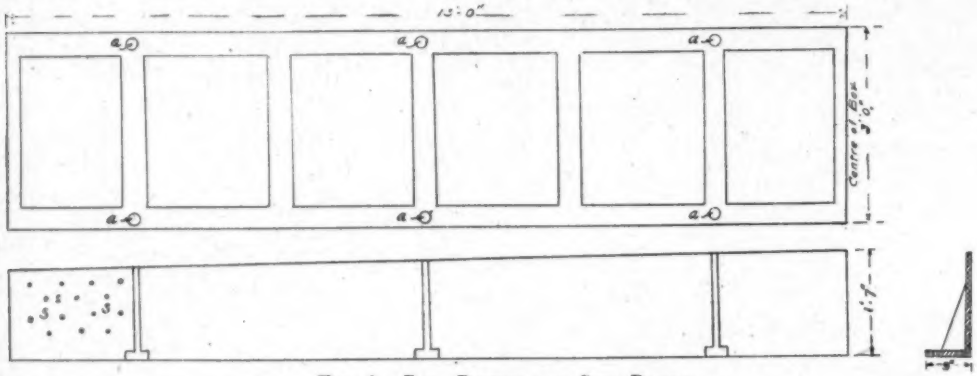


FIG. 6.—BOX BOTTOM AND SIDE PLATES.

Referring to Fig. 4, an iron pattern is made to this section and secured to the plate (*e*, Fig. 5), which is attached to the ratchet-head section (Fig. 8) by a pin passing through *f*, Fig. 5.

The machine is set at the top end of the moulding box, the plate (*e*, Fig. 3) resting on the top edge of the box. A dummy block cut to the shape of the pattern is placed level with the leading edge of the pattern (*g*, Fig. 2).

The machine is set in motion and sand is filled in through the hopper (*h*, Fig. 2), passing through the rollers *i* on to the spiral conveyer *j*. Sufficient resistance should be placed behind the dummy block so that the conveyer will gather sand up to the required density, and when this has been attained the travelling motion is set on by the clutch on the worm wheel (*k*, Fig. 3) operating on the shaft *l*. In this manner the machine will travel the length of the box, the springs on the frame-plate *x*, Fig. 8, allowing the pattern to ride on the moulding box edge, which should be made to give the required camber to the mould.

The shaft (*m*, Fig. 2) supporting the conveyer extends beyond the leading edge of the pattern and forms the vent for the centre of the mould. The plate *n* is the width inside the moulding box and extends to the hopper *h* forming a backing for the sand. A false box part about 3 ft. long is required at the end of each box for the conveyer to finish in.

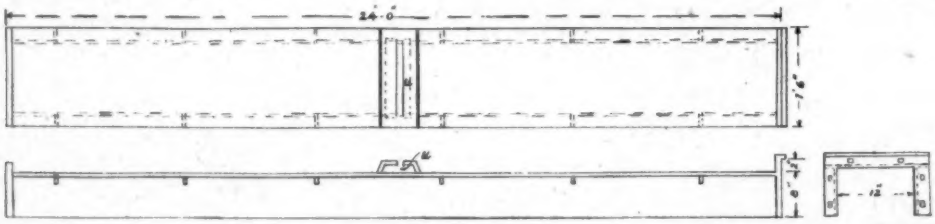


FIG. 7.—PLAN AND SECTION OF CASTING. END VIEW.

The pattern is then withdrawn by the hand wheel *o*. The machine should be arranged to run on a bogey so it could be moved to the next box. The false box is removed and short boards placed in the ribs (*p*, Fig. 4) and the mould ends finished off square, leaving about a foot of space each end of the box.

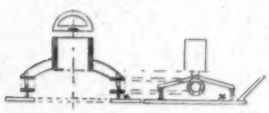


FIG. 8.

FIG. 9.

FIG. 10.

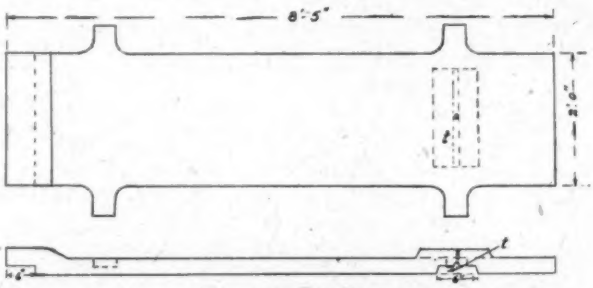


FIG. 11.—TOP PLATES.

Dry sand cores (Fig. 9) forming the flanges are placed in each end, one of these having the runners

in at *q* and one having the vent carried through at *r*. Bars are placed through the holes (*s*, Fig. 6) in the box side, a piece of plate put against them and sand rammed at the back of the cores. Fig. 10 is for making the brackets on the sides. A strip is held in the side of the mould and the tool pressed in to the desired depth. The inside, which is hollow, will lift the sand out.

The top of the mould is covered with cast-iron plates (Fig. 11) divided to suit the greatest number of castings, and should set in a hinge or some similar device to ensure easy setting and lifting away. The depression *t* is formed in the plates to take the core *u*, Fig. 7, fastened through the top plate. The plates should be warm and coated with suitable material, then placed on the mould just before casting and taken off as soon as possible after. A good, open sand should be used and the vent only carried off at one end, suitable channels being made to allow the air in the mould to escape.

Crudall Oil Furnace and Burner.

The Crudall burner for oil fuel, which was recently inspected by our representative, is the result of several years of experimental work and use with the object of obtaining very high temperatures for metal refining. An essential feature for such work is that the burner shall not have the slightest liability to choke when being used, and shall disintegrate the fuel so finely that the most intimate association possible between fuel particles and air is secured. The final development of the burner is shown in Fig. 1. The oil is fed by gravity through a regulating cock to the inlet A, and drops on to wire coils or springs B. At C the air is introduced under a pressure of 4 to 6 lbs. per sq. in., and then

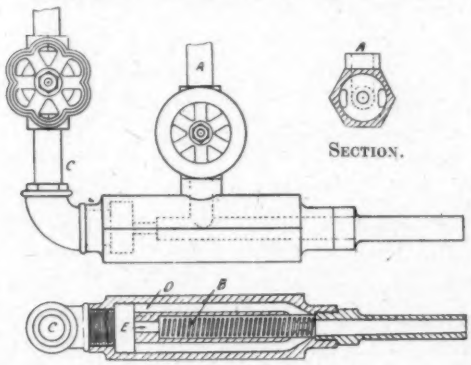


FIG. 1.—DETAILS OF CRUDALL OIL-FUEL BURNER. LONGITUDINAL SECTION.

splits up, passing partly through the two side chambers or passages D and partly through the passage E to the chamber containing the coils B. The oil dropping on to the latter from the inlet A thus encounters the air current, which splits it up into fine particles, the whole taking presumably a whirling motion along the coils. On reaching the nozzle it is augmented by the air supply from the passages D and passes out a finely-divided admixture of oil particles and air. So efficient is the mixing that it is only a matter of seconds before the burner, on a light being applied, is operating at full pressure and heat, starting up from cold. Very little heat appears to be necessary in the atomising or vaporising of the fuel in the burner.

The operation of the burner is extremely simple, and since there are no needle valves or fine passages involved in its construction, the apparatus cannot become choked in use. The flow of oil is from the full bore of the inlet, regulated only by a cock or valve at gravity pressure, and the makers claim that the atmosphere of the furnace in which it is used can be regulated to an oxidising or reducing

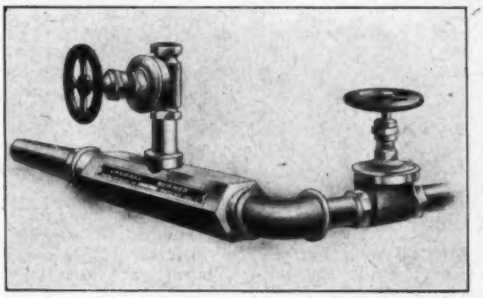


FIG. 2.—CRUDALL OIL-FUEL BURNER.

condition at will and without any trouble. Further, any available oil, from heavy crude Mexican petroleum to creosote or the light oils, can be burned in the Crudall burner. The intimacy of mixing and the effectiveness of the method of disintegrating or atomising the oil is evidenced by the fact that the burner is used in melting nickel and even platinum.

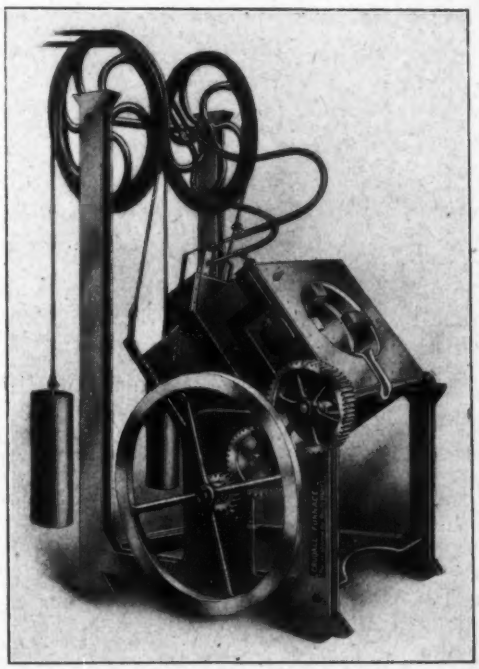


FIG. 3.—CRUDALL TILTING CRUCIBLE FURNACE, OIL-FIRED.

The designers and users of the burner in question have also developed a design of tilting crucible furnace which, though primarily intended for oil firing with the Crudall burner, can be also fired with gas, such as high-pressure gas. The furnace is shown

herewith. The crucible is fixed and is poured by tilting the body of the furnace on a centre at the spout axis, this ensuring a steady stream of metal at the same spot however the body is tilted. The tilting is by geared control and the weight is balanced by two counter weights slung over pulleys at the rear. A few ounces is thus sufficient to turn the gearing when the pot is fully loaded.

The burner operates round the crucible tangentially, so that there is no "cutting" action on the latter; and the products of combustion pass away by a suitably arranged hood. This furnace has proved very successful in melting non-ferrous alloys of relatively high melting points, and, particularly with oil fuel, affords the advantage of obtaining the desired heat very rapidly instead of keeping the metal in a semi-fluid state for a long while so that it can absorb gases.

The crucible can be taken out by withdrawing the side checks or holding blocks at the top rim, when the crucible can be removed, though it is quite safe and firmly fixed when the blocks are in place. Both furnace and burner are now being marketed by Mr. E. Petersson, M.I.M.M., consulting engineer, 28, Victoria Street, London, S.W.

In connection with the use of oil fuel for melting it is interesting to note the results obtained in some recent tests with a Crudall burner melting aluminium. Three 500-lb. crucibles were used, requiring not more than 4 gals. of 0.9 gravity Mexican fuel per hour; and there was melted in 20 days metal to the amount of 33 tons, 3 cwts., 2 qrs., with a fuel consumption of approximately 1¼ gals. per cwt. The three crucibles in this furnace did the work of 9 coke furnaces, and the crucibles lasted 16 days as against 12 to 15 days with coke or gas.

Collapsible Core Bar for Pipe Castings.

A collapsible core bar for use in casting iron pipes has been patented by C. M. Sims and H. W. Lee, Anniston, Ala., U.S.A., and is described as follows in "The Iron Age":—This arrangement is designed as a substitute for the rigid bar which has to be wound with hay rope and coated with clay and baked. The bar consists of an outer shell of six segments, three of which are comparatively wide while the others are relatively narrow, attached to a central shaft by circular heads at each end, a set screw being employed to fasten the heads to the shaft. The segments are attached to the heads by links and are independent of each other.

The links and heads are arranged so that the small segments can be lifted up with a sliding motion until a seat placed just below the links comes in contact with and rests upon a seat attachment on the under side of the upper head. As the staves are lifted they are drawn in, thus reducing the diameter of the core until further motion is arrested by the contact between the seat and the head. The links connected with the larger segments are constructed and attached to the heads so that a downward movement only is allowed, this motion, as was the case with the smaller segments, reducing the diameter and being checked by seats coming in contact with the lower head.

On the upper head is a locking device consisting of pivoted wedges driven under lugs on the segments, which is relied upon to keep them in a rigid, expanded position. The links are at right angles to the central shaft and the segments, except for a slight forward inclination given the links to the smaller segments, which is relied on to accelerate and facilitate their upward movement. Fig. 1 (*a*) shows the bar before collapsing, while *b* and *c* show the ends of the bar as assembled and also after collapsing has taken place.

The bar is prepared for the flask by simply covering it with clay while the segments are expanded and locked and smoothing the outer surface. It is then baked and blacked in the customary way and placed in the flask. After the casting has been poured, the locking device is loosened and a crane is attached to the projecting ends of the small segments by a triangle of wire. A single upward pull collapses and lifts the bar out of the flask, the smaller staves being drawn upward and moving inward on the pivoted links until their seats strike the heads. The moving inward of the smaller segments breaks the continuity of the outer shell and causes the larger segments, which are unsupported and attached to pivoted links, to drop and be drawn in. When the small segments come to rest, the upward movement of the crane lifts the whole bar, the diameter of which has been reduced by several inches at all points, and it comes from the flask freely and easily.

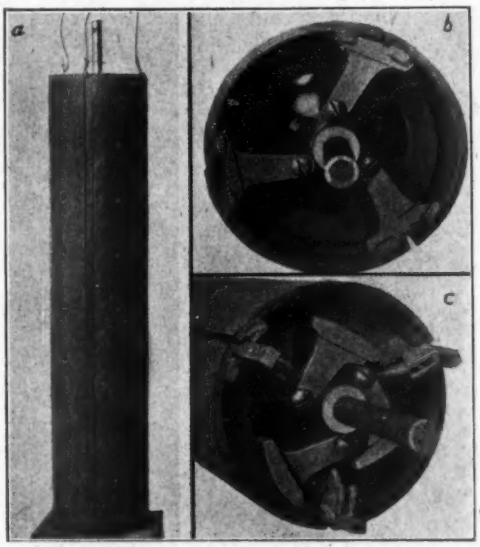


FIG. 1.—CORE-BAR FOR CAST-IRON PIPES. (*a*) SHOWS CORE-BAR ASSEMBLED READY FOR MOULD; (*b*) AND (*c*) SHOW END VIEWS OF THE BAR ASSEMBLED AND COLLAPSED, RESPECTIVELY, AND THE POSITION OF THE LINKS CONTROLLING THE MOVEMENT OF THE NARROW BARS.

It is pointed out that the bar assumes its expanded shape by its own motion as soon as it is placed by the crane, it being simply necessary to lower the bar into a pit after drawing it. The weight of the bar resting on the larger segments is relied upon to force them up until the connecting links are at right angles, while the weight of the smaller segments causes them to drop back into their expanded position. The locks are knocked in place, and the bar is ready to be used again, the time required to expand the bar after it has been collapsed being less than 1 min.

New Reversing Appliance for Open-Hearth Furnaces.

A method of reversing the direction of the gases in open-hearth furnace flues, by means of brick-lined tubes acting on the principle of a railway switch, has been developed by the Blair Engineering Company, New York. The method is now in use by the Brier Hill Steel Company, Youngstown, O., and is being installed by the Inland Steel Company, Indiana Harbour, Ind., in its new open-hearth plant. From a description recently published in " The Iron Trade Review " we gather the following particulars.

Figs. 1 and 2 show that the device consists simply of a swinging section of flue, by which the flue to or from the furnace chambers may be made a continuous flue from the gas producers to the furnace at one end, and from the furnace to the stack at the opposite end, and by which the functions of these flues may be readily reversed without any valve.

Each flue is distinct, and completely separated from every other flue, there being no partition walls, so that no leak can occur between the gas

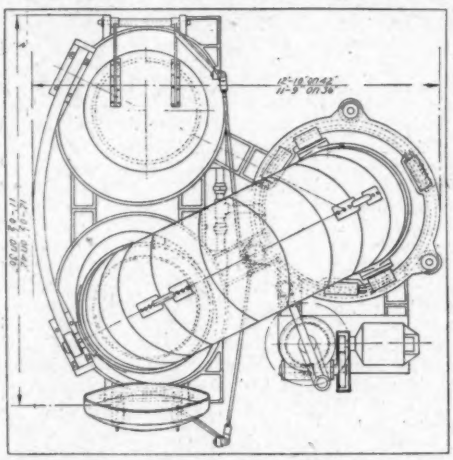


FIG. 1.—ELECTRICALLY-OPERATED SWINGING GAS FLUE CONNECTION.

and draft flues. As shown in Fig. 2, *A* and A^1 are regulating valves for controlling the supply of gas to the furnace. Adjacent are placed goose-neck tubes constructed of steel plate lined with firebrick, connecting the gas flue with the furnace at one end and connecting the opposite end of the furnace with the stack, through water-sealed connections at each end of the tubes. A heavy tube of similar construction to the goose-neck gas tubes connects the large air chamber on the outgoing end of the furnace with the stack. Steel-plate covers are provided to regulate the supply of air to the furnace. Hydraulic cylinders reverse the mechanism as illustrated. This can also be accomplished by motors, as shown in Fig. 1. The method of reversing the tubes is shown in Fig. 2. The gas comes from the producers, in either overhead conduits or underground flues, to the regulating valves, *A* and A^1. In the figure *A* is open, admitting the gas to the furnace through the goose-neck tubes. The air regulating cover is also open, admitting the required amount of air to the same end of the furnace. The products of combustion are passing out from the opposite end of the furnace, through suitable tubes, to the stack. To reverse the furnace, the gas-regulating valve, *A*, is closed by means of a hydraulic cylinder, or motor, which at the end of its stroke releases the valve actuating the cylinders or motors, which thereupon swing the three tubes over into the reverse position. The gas-regulating valve A^1 is now opened by means of its hydraulic cylinder, or motor, and the furnace is reversed.

In reversing the draft, the gas- and air-regulating valves are adjusted by automatic means to the same position they occupied in the previous period of operation on their end of the furnace, so that the amounts of gas and air admitted are the same as they were when the furnace was previously reversed. When a repair becomes necessary the connecting tube is so placed as to become a part of the draft system operating from the outgoing end of the furnace. If the repair is required on the gas

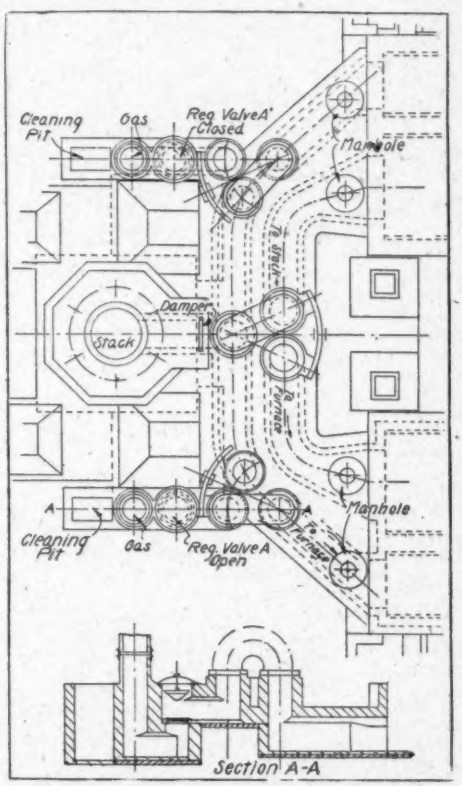


FIG. 2.—PLAN SHOWING ONE OF SEVERAL ARRANGEMENTS OF O.H. FLUES.

tube, that part is disconnected, breaking the connection through that flue to the stack with the same effect as a damper in that flue. The draft then all passes through the air tube to the stack and the furnace continues in operation. If the repair should be required on the air-flue connection, this flue is disconnected, and the draft passes through the gas tube to the stack.

Where waste-heat boilers are used in connection with open-hearth furnaces, a single tube, similar in construction to the regular reversing mechanism but having an area equal to the sum of the areas of the gas and air tubes, is provided by this system to divert the products of combustion to either the boiler or stack.

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Monel Metal.*

By C. M. Biddle, Jun.

Monel metal is a natural alloy of nickel and copper, containing approximately 68 per cent. nickel, 1.5 per cent. iron, and 30.5 per cent. copper. In the process of smelting and refining the ore, the nickel and copper are not separated and they appear in the finished alloy in the same relative proportion as found in the ore. The nickel ore is obtained from the deposits at Copper Cliff, near Sudbury, Ontario, Canada. It is pyrrhotite, a sulphide of copper, nickel and iron, and is found intimately mixed with granite rock as an agglomerate mass, and not in the form of veins. This particular nickel ore has an approximate analysis of 5.5 per cent. nickel and 2.5 per cent. copper, or a ratio of 2¼ parts nickel to 1 part copper. In the metallurgical treatment of this ore the metals are separated from the rock and earthy matter by a process of smelting, using blast furnaces and Bessemer converters. By this treatment the nickel and copper are obtained in the form of an impure alloy. The refining of this impure alloy of copper and nickel was by no means a simple task, and it was only after four years of experiments that it was possible to place on the market an alloy of copper and nickel, under the name of "Monel metal." In appearance this metal is of a silver-white colour; in fact, it cannot be distinguished from pure nickel. It takes a brilliant finish which it retains indefinitely. On heating or prolonged exposure, the polished surface assumes a grey cast which can be removed by a polishing cloth. It melts at 1,360 deg. C. (2,480 F.) Compared with copper it is about of an equal weight but considerably harder, and yet is so ductile that it can be spun or drawn into the finest wire. It shows relatively smaller expansion and contraction changes than copper, and three times greater tensile strength. The metal can be readily soldered with killed acid, brazed with ordinary brazing solder, and welded either electrically or with oxy-acetylene torch. Like iron and steel, it is produced in cast form or in rolled rods, bars, and sheets. While the physical properties of this alloy excel those of mild steel, still it machines easily. Monel metal finds its greatest uses and possibilities as an engineering alloy, owing to its strength and resistance to corrosion. In rolled and annealed condition it is equal to nickel steel, as the following comparisons will show:—

	Monel Metal.	Carbon Steel Annealed.	Nickel Steel Oil Tempered:
Tensile strength lbs. ..	95,000	80,000	95,000
Elastic limit .. lbs. ..	50,000	40,000	65,000
Elongation, per cent. in 2 in.	42	22	21

In the majority of cases where steel or acid-resisting bronzes are attacked, the action of the same agent on Monel metal under similar conditions is but slight or of no effect whatever. A very interesting test was an immersion of this alloy in cold 40-deg. sulphuric acid for fifty-six days. At the end of this period, no loss of weight was shown. Another test, much more severe, was where the metal in finely-divided conditions, as lathe turnings, was boiled for forty-eight hours in the same acid as above mentioned; at the end of this time it exhibited a loss of less than 0.5 per cent. In sea water, where bronzes, copper or steel, exposed alternately to the air and salt water, become rapidly pitted, the metal remains wholly unaffected. Under weather conditions, where the atmosphere is charged with corroding fumes, as about gas houses, smelting plants, or chemical manufactories, roofs of Monel-metal sheets have fully withstood the test. In connection with various manufactories where chemicals are used, various articles as containers, pumps, etc., made from this metal, have given universal satisfaction. It is in the form of castings that this metal now finds its greatest demand. During the past six years the United States Government, through the Navy Department, has made such conclusive tests that this is the best material for marine work, that it is now being specified for such outboard connections of battleships as would be rapidly corroded by sea water. Valve seats and liners for pumps of this metal have been found to be far superior to bronze. Liners show no scoring, and after a short period of use assume a glass-like finish which reduces the packing to a minimum. As evidence of this, a very interesting experiment was conducted by the United States Navy on the battleship New Hampshire. A number of pumps were equipped with Monel-metal liners, rods, and valve seats; other similar pumps were equipped with bronze. At the end of six months the bronze equipment had to be replaced, while the Monel-metal fittings showed practically no wear. With this test as a basis, the United States Navy now requires that pumping equipment of its ships be fitted with Monel metal. In connection with very high steam pressure where superheated steam is used, the alternate heating and cooling of bronze or steel valve seats cause them to become granular and crumble away. Monel metal has been given a severe test and found entirely satisfactory. Monel metal castings have found a varied use where chemicals or other corroding agents must be handled, such as in washing apparatus, acid conductors, in refrigerating plants where the ammonia causes rapid corrosion, in handling of mine waters, and for pickling apparatus in connection with the rolling of steel sheets and tinplate.

* Abstract from the Journal of the Ohio Society of Mechanical, Electrical, and Steam Engineers.

Aluminium Bronze on the Canadian Boundary.

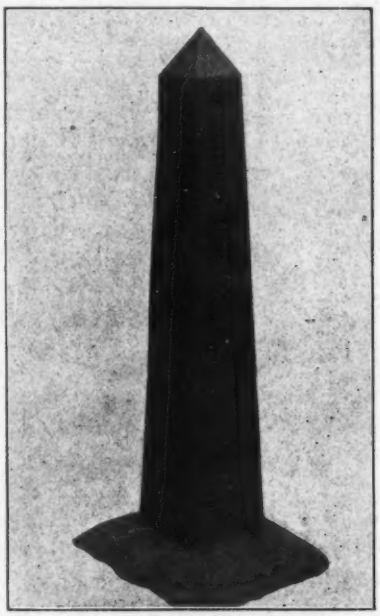
By Max McD.

Establishing the International Boundary between Canada and the United States was not completed when Ashburton and Webster had sweated out an agreement in the heat of a July day in Washington. There were other treaties and conventions to follow, and then the toil of digging holes, and carrying iron, and climbing mountains, and fording streams and setting posts.

The initial work was astronomical in nature. This was followed by the placing of mounds of rock and earth at intervals. In the mounds, at stated intervals, plates of iron were set, around the rim of which there was stamped "U.S. and British Commission." Later, it was agreed to place permanent posts from the summit of the Rockies westward to the Pacific Ocean and from the same point eastward to the Lake of the Woods. These posts were intervisible and east of the Rockies were of iron, made in one piece. For the thousand miles of mountains west of the continental divide aluminium

bronze was the material of manufacture, and the posts were constructed in sections to facilitate transportation.

Each of the three sections of the boundary post weighs 65 pounds. They stand one on top of another in a foundation of cement, and are held together by a rod screwed into a thread in the top section and fastened in the cement at the bottom. On these posts there is moulded alternately on the four faces: "Canada"; "Convention of 1818"; "United States"; "Treaty of 1908."



POST NO. 925 ON THE INTERNATIONAL BOUNDARY AT LAKE OF THE WOODS, CANADA.

To number the 925 posts that had been set was the last duty of the engineers. This was done with a high-power hand drill working through perforations in a small brass plate. Small holes were drilled in brass plates making figures from 1 to zero. The holder was then clamped to the post and the drill inserted in each little hole till an impression was made in the post.

It seems a most fitting thing that the celebration of one hundred years of peace between two nations should fall upon the very month of the completion of the work of marking the boundary that separated them.

USES OF COMPRESSED AIR.—Compressed air is a valuable servant in both brass and iron foundries, and finds application in the operations of the chipping hammer, sand rammer, moulding machine, sand-blast, and sand riddle, while the air nozzle for blowing dirt from moulds is well known. The compressor should be as nearly dirt-proof and fool proof as possible. Different sizes and types of compressors can be obtained to meet almost any foundry requirements. A suitable pressure is 60 to 80 pounds per square inch for service lines of the foundry. Piping should be as direct as possible with no undrained pockets or loops where moisture can accumulate and where freezing can occur in cold weather.

The Analysis of Aluminium and its Alloys.

In a Paper by MR. W. H. WITHEY, presented at the annual meeting of the Institute of Metals, methods are described for the analysis of alloys of aluminium and copper, also aluminium and zinc, and details given of a method that was used for the complete analysis of metallic aluminium. This latter method is made use of in the analysis of alloys of aluminium containing magnesium, for which purpose it possesses distinct advantages owing to the fact that large quantities of the alloy may be used in the analysis. In this method use is made of the fact that tartaric acid is capable of preventing the precipitation of aluminium by ammonium sulphide, while at the same time zinc and nickel are quantitatively precipitated. Manganese is only partially precipitated. The filtrate left after the removal of the sulphides produced by sulphuretted hydrogen in acid solution, and by ammonium sulphide in alkaline tartrate solution, is acidified and concentrated. The solution filtered from sulphur is made ammoniacal, and the magnesium precipitated with sodium phosphate. The precipitate is redissolved. The precipitate is next dissolved in dilute nitric acid and any manganese, which is usually present, determined by a colorimetric method and calculated into the equivalent weight of manganese pyrophosphate which is then deducted from the magnesium pyrophosphate obtained. The manganese is separately determined in another sample. The Paper contains analyses of solutions containing aluminium and known amounts of iron, zinc, magnesium, and nickel, from 0.25 to 1.0 per cent. The results obtained indicate that the method is very reliable. The figures obtained in the analysis of an alloy of a well-known type are also in excellent agreement with those made by a standard method.

The method recommended for the analysis of the alloys of aluminium and zinc consists in adding to the solution an excess of caustic soda. The hydroxides first precipitated are thus dissolved, and on passing sulphuretted hydrogen the zinc is precipitated. The precipitate is dissolved and the zinc, after the removal of traces of aluminium, is determined as phosphate. To obtain a perfect separation certain precautions are necessary, which are fully discussed by the author.

FOUNDRY FLOORS.—A good foundry floor is a great asset and a valuable aid in producing good work. Old moulding sand makes a fairly satisfactory floor, but must be kept wet and unless it is constantly levelled off to the right height the floor becomes uneven. Bricks are not very satisfactory, and ordinary concrete is unsuitable, for the reason that hot metal will crack it. Iron floor plates, when made sufficiently thick and large, are excellent, and are used very extensively in the large brass rolling mills, particularly in the casting shops. The objection to their use is that of cost. The following concrete mixture is recommended by one writer:—Cement, 1 part; sand, 3 parts; gravel, 4 parts; iron borings, 1 part. It is stated that molten metal falling on a floor of this composition does not crack or disintegrate it.

SALT AS A FLUX.—Common salt, or chloride of sodium, is frequently used as protective cover in making brass. It is held by many to also act as a deoxidiser, though to what extent is still problematical. In so far as it does deoxidise metal, that effect is probably produced by the dissociation of the salt at the temperature of molten copper, breaking up into metallic sodium and chlorine which escapes. The metallic sodium in that case would act as a reducing agent and reduce the oxide of copper.

Non-Ferrous Notes.

Flemish Brass.—This name refers to the finish of the brass. The metal is first given what is called the antique finish. This is done with a tampico wheel and fine pumice used wet, to get the gloss from the brass. Sand blasting will also serve. The article is cleaned and dipped into a solution and allowed to remain until the desired colour is obtained, when it is removed and carefully dried. The solution in question is made as follows:—Mix 1 quart of muriatic acid with an equal amount of water; add 1 oz. of white arsenic and boil until it is dissolved, then mix with 9¾ gallons of water (making 10 gallons in all). Heat to 150 deg. F., and just before using add a small piece of liver of sulphur (about ½ oz. in weight) to the solution and stir.

Casting Nickel Silver.—Founders who are used to bronzes, gunmetal and brasses often experience trouble in handling the nickel-copper alloys, though there is a temptation to use them for special castings that have to resist corrosive action, such as valves, stuffing boxes, pumps, etc. Unfortunately the nickel alloys are very difficult to cast in a brass foundry They have to be treated like steel, and this particularly applies to Monel-metal, which is one of the best for such work. Even though it be cast without difficulty, perfect castings are difficult to obtain. The high melting point of nickel (1,450 deg. C.) is largely the cause of the difficulty, for with such a metal the ordinary furnace may not be efficient, while obviously the mould must be much more refractory than for bronze.

Nickel and its Uses.—Nickel has been familiar to mankind for many years, for an alloy of copper, nickel and zinc, called Packfong, has been known to the Chinese since time immemorial, and it is stated that an alloy containing 77.58 per cent. of copper, 20.0 per cent. of nickel and 1.72 per cent. of impurities was used for coinage by Ethydemos, who reigned over Bactria about 235 B.C. It was only, of course, in comparatively recent times that the pure nickel was produced. Nickel is employed in small amounts in a number of alloys; in steel on account of its hardening properties (this use taking the greater part of the nickel refined), and in non-ferrous alloys such as Monel-metal, nickel-silver, etc., owing to its strength, durability and white colour. Its use in a pure state for electro-plating is well known, for which use its resistance to corrosion and tarnishing especially recommends it.

Titanium in Alloys.—The influence of nitrogen in non-ferrous alloys, particularly those of aluminium, is still little understood, though it is probable that a study of nitrogen occurrence and removal will pave the way to greater success with aluminium as a founder's metal. In this connection there appear to be considerable possibilities in the affinity for nitrogen which titanium possesses. The presence of nitrogen in copper is not yet a settled matter, but if copper actually does absorb it, nitrogen would undoubtedly tend to lower the electrical conductivity and probably the physical properties. The action of the titanium is to combine with the nitrogen and rise to the top of the metal as a nitride, which, being a non-metallic substance, floats on the metal as a slag. It is undoubtedly to this action that the beneficial effect of titanium on aluminium-bronze is due, and the nitrogen removed is probably mainly from the aluminium.

Aluminium-Brass for Name Plates.—A cheap mixture, with a good colour, which has been recommended for casting name plates for machinery and similar purposes, is made by the addition of aluminium to a copper-zinc mixture. To 100 lbs. of a mixture of half copper and half zinc is added 2 oz. of aluminium. This enables the mixture to cast well in the intricacies of the name-plate mould, and when the metal is hard it can be drilled quite easily. Beyond facing with a grinder, such castings are not usually machined. The colour of the alloy is orange, and there are not usually found the pin-holes that frequently are found in copper and tin mixtures. The moulds can be cast flat, as the metal flows readily. The heat for pouring is that at which the surface of the metal does not "flare" when undisturbed, but when stirred with a skimmer a slight "flaring" takes place. If poured at too high a heat the casting will be drossy. The alloy is not brittle, although it will not bend. If a softer mixture is desired, less spelter may be used.

Recovery of Metal from Grindings.—It is usually a rather profitless job to attempt to recover the metal in the grindings from the average foundry, for though the metal content may be considerable the actual recovery may not repay the time and fuel expended. If they are melted alone, the waste is frequently very great and very little yield of metal is obtained. A flux which some users find to give good results in this work, producing a fair yield of clean metal, is composed of equal parts of plaster-of-Paris, soda-ash, common salt and fine charcoal. These are mixed together and then mixed with the grindings in the proportion of one of flux to ten of grindings. The flux and grindings are well mixed, melted and stirred from time to time and then poured into ingots without skimming. When the ingots are cold the flux may be removed from the metal with a light blow from a hammer. This flux is also claimed to remove the greater part of any iron which may be present.

Cobalt and its Possibilities.—So far cobalt has not entered largely into non-ferrous alloys, except in the case of Stellite (cobalt-chromium-tungsten) and similar alloys, though there appears to be a good future before it. Cobalt is a metal very similar in its properties to nickel, and is much the same in appearance. It has a slightly reddish tint, although not very perceptible. In chemical properties cobalt closely resembles nickel except that its salts are pink or red while those of nickel are green. Cobalt can be electrodeposited in the same manner as nickel from a double sulphate of nickel and ammonia. The deposit has the appearance of a nickel plate. In alloys, however, cobalt seems to have greater hardening properties than nickel, and its use in steel is becoming more important. In this direction alone it is probable that a much greater consumption of cobalt will occur. With a melting point of about 1,490 deg. C., or a little higher than nickel, cobalt offers similar melting difficulties in the non-ferrous foundry. Its specific gravity is the same as nickel, or 8.8, and its atomic weight 58.97, that of nickel being 58.68.

Calcium as a Deoxidiser.—The use of metallic calcium for purifying molten metals has considerable possibilities before it. Calcium readily combines with oxygen, nitrogen and hydrogen with rise of temperature, thus increasing the temperature of the molten bath and at the same time causing vigorous ebullition, whereby the gases, oxides and portions of slag, dissolved or mixed with the bath, are brought to the surface. The removal of the oxides and similar products naturally gives a denser casting with a homogenous texture. As calcium does not alloy with iron, but always goes into the slag, an excessive addition to iron alloys is not injurious, as in the case of refining agents such as aluminium. Calcium also promotes a thorough mixing and uniformity of the molten bath. For the complete deoxidation and refining of a normal melting of iron, an addition of about 1 lb. of calcium to 2,000 lbs. of metal is required. Calcium is also generally recommended for use in the founding of copper and other metals, but then the addition should not exceed 0.05 per cent., or 1 lb. to 2,000 lbs. of metal. Metallic calcium readily oxidises on exposure to the air, and requires to be kept in air-tight boxes. One method of manufacture, patented by the Bitterfeld Electro-Chemical Works, Germany, was by an electrolytic process from the molten chloride.

Colouring Bronze Castings Brown.—For some purposes it is often desired to give bronze castings a brown appearance, and this can be done by the use of liver of sulphur. While the latter substance blackens copper, it gives a pleasing brown surface to bronze castings. The solution to be used consists of 1 gal. of water and 1 oz. of liver of sulphur. It should be used cold, and a stone crock, iron kettle,

or a wood tank can be employed. The casting is first cleaned from any grease or oil, and may be treated with benzine if very greasy. It is then scoured with pumice and water and rinsed, when the surface is ready for colouring. Dipping in a mixture of equal parts of sulphuric and nitric acids may be used for cleaning, but scouring is preferable. The casting is then immersed in the liver-of-sulphur solution and allowed to remain for 10 min., when it will be found that it has a colour that is variegated and not very pleasing—somewhat of a slate colour. The casting at this point is removed from the solution, rinsed well in cold water and dried, after which it is scratch-brushed with a brass scratch brush, on which appears an excellent brown-bronze colour. On yellow brass nothing but an uneven stain is produced. On bronze there seems to be no danger from a prolonged immersion in the liver-of-sulphur solution, as no deeper colour than the brown finish is given.

Iron in Copper.—Copper and iron do not alloy well. Iron can dissolve 8 per cent. of copper and copper can dissolve about 3 per cent. of iron. But the alloying of copper and iron has never been productive of good results. If copper and iron are melted together and poured into castings, the alloy is not homogeneous, but shows nodules of iron that separate out. The reason copper and iron will not alloy under ordinary conditions is the presence of the carbon that the iron absorbs in melting in a graphite crucible. If the iron and copper in the correct proportions be melted together in a clay crucible so that no carbon can be taken up, the resulting alloy is homogeneous and free from any separated nodules. The carbon displaces copper in the iron and leads to the formation of two conjugate liquid solutions, so that the distribution of the constituents is irregular. The alloys of copper and iron are red when the amount of iron is only a few per cent. When more is present, they become pink and finally grey, like iron. The copper is hardened as the proportion of iron is increased. The alloys are made with wrought iron and copper melted together. The alloys low in iron are not magnetic, but as soon as the iron rises above a few per cent. they become slightly so. The presence of iron in steam metal and similar alloys is liable to produce dark spots or patches on the surface, or the whole surface may be discoloured.

Copper-wire Scrap.—The use of fine copper-wire scrap is attended by the difficulty that the ratio of surface to total bulk is relatively high, and the oxidised surface is much more than in heavier forms of material. A very good class of scrap from the founder's standpoint is the overhead conductors or wire from electric tramways and railways. This is generally about ⅜ in. diameter, and consequently of good bulk for the surface exposed. Moreover, owing to its service requirements it is essentially of high purity, as otherwise it would not have the required electrical conductivity. The conductivity is a safer and more accurate test for the presence of impurities in copper than is chemical analysis. It should be remembered, however, that the alloy known as silicon-bronze is used for the same purpose, owing to its greater strength and resistance to wear, although it has a higher electrical resistance than copper. It is more particularly used for curves and on long spans, where copper might be subject to too great wear. Silicon-bronze is equally suitable for the founder, as it is practically pure copper with a little tin and a trace of silicon. In making the silicon-bronze wire only 0.05 per cent. of silicon is added, and this is nearly all lost by reason of combining with any oxygen present. As made, the following mixture is generally employed :—Copper, 98.55 per cent. ; tin, 1.40 per cent. ; silicon, 0.05 per cent. Silicon-bronze wire has practically the same colour as copper and in the form of scrap it cannot be distinguished, but when clean it has a little lighter shade than pure copper.

Manganese-Bronze Difficulties.—Manganese-bronze is a very difficult metal to cast in such forms as valves or other castings to stand pressure, owing to the presence of dross. The reason for the failure of manganese-bronze for work to stand pressure is the fact that it contains aluminium, which is necessary for successful casting. When aluminium, or any alloy containing it, is melted, oxidation takes place and this oxide intermingles with the metal that is poured and causes leakage. Owing to this trouble the making of manganese-bronze castings to stand pressure is not a commercial proposition. The castings can be made and good ones can be obtained, and when they are good they cannot be excelled, but the number of bad ones is generally excessive. To make good castings the metal must be poured at as low a heat as possible, usually at a temperature so that no smoke is given off from the undisturbed surface, though if the metal is agitated with the skimmer a slight amount of spelter smoke is evolved. This rule applies to the pouring of castings except those which are small or thin. If poured at too high a heat and so that the metal is smoking freely from the undisturbed surface, then the castings will be full of dross. Of course, the temperature must not be so low that the metal is pasty when poured. Manganese-bronze must also be cast "quietly," or without any unnecessary agitation. The more the metal is disturbed the greater the quantity of dross formed. The mouth of the crucible or ladle should be held very close to the pouring gate. Some founders claim that the runner should be as long as possible, so that any dross there is in the metal when it enters the mould will remain in the runner. For large castings a horn gate to fill the mould from the bottom is advised when practicable. The sand should be as dry as possible, so that there will be no bubbling of the metal when it enters the mould.

Annealing of Nickel-Silver.—In a Paper, presented at the annual meeting of the Institute of Metals last month, Mr. F. C. THOMPSON indicates the results of exhaustive experiments on the annealing of nickel-silver, which can be briefly summarised as follows :—(1) Tensile tests on the alloys containing from 7 to 28 per cent. of nickel in the cast state show a distinct increase of strength as the nickel content is increased, without, however, appreciable change in the elongation or reduction of area. The results of compression tests are remarkably constant throughout the whole series of alloys tested, changes of the nickel content exerting in the cast state very little effect. (2) Deoxidation of the molten alloy with 0.25 per cent. of manganese results in a marked improvement of the behaviour of the material in the rolls. (3) As the nickel content of the alloy increases the specific volume is lessened, which is also the result of increasing the ratio of the copper to the zinc. The density is slightly greater in the work-hardened state than after annealing, and also in those alloys which have been deoxidised. (4) The electrical resistivities of the alloys after being reheated at increasing temperatures reveal a well-marked transition between 300 deg. and 400 deg. C., which is shown also by thermo-electric curves, but not by inverse-rate heating or cooling curves. The specific resistance of the alloy is determined chiefly by the nickel present. With the exception of the alloys containing only 7 per cent. of nickel the resistance is practically the same in the hard-drawn and in the annealed states. (5) Torsion and hardness teats show well the temperature at which annealing starts, which increases, as the nickel content is raised, from 370 deg. C. with 7 per cent. to 600 deg. C. at 28.6 per cent. The hardness results show a sharply-localised peak at about 320 deg. C. The influence of time on the temperature at which annealing commences is negligible, though the temperature of the critical point is slightly lowered with "soaking." (6) Tests made of the Brinell hardness and the resistance to alternating stress (Arnold) indicate that the impurities usually present are practically without effect on the properties, at the temperature of annealing. (7) The results indicate that the tendency of such alloys to "burn" is increased (*a*) by increasing the nickel content (*b*) as the ratio of the zinc to the copper is increased, and (*c*) with the amount of the impurities present.

Training Foundry Leaders.

It is generally recognised that in attacking the problem of foundry education there are two practically separate matters to be dealt with, the first being the general training of the operatives or craftsmen and the other the training of foundry formemen or leaders, who require a wide range of qualifications that the moulder does not need to possess. The following details of a scheme of training for foundry leaders were given in a Paper by Mr. E. A. Johnson before the American Foundrymen's Association :—

It is self-evident that the apprenticeship system, as it has been carried on in many foundries, does not produce men who have the proper training to succeed in managing a plant in accordance with the modern ideas that we all are prepared to accept. It is also self-evident that practical experience alone is no longer sufficient.

Wentworth Institute, Boston, Mass., U.S.A., realising this situation, has determined to offer a new two-year course designed to train men to fill this need. This new course is intended to train young men exclusively for advanced positions in the foundry industry, for those positions which require a combination of skill, intelligence and technical knowledge. It is planned to give both a broader practical training and a more thorough comprehension of the scientific principles that underlie modern foundry practice than can be obtained through practical experience in most commercial shops to-day. The work of the course, which we call foundry management and operation, is divided into seven general headings.

(1) *Shop Experience.*—Three-eighths of the entire time during both of the two years is given to gaining shop experience in bench and floor moulding for iron, brass and other alloys, and in machine moulding, core making, finishing and in cupola management. The plan is to include all the common types of work that are met with in the best modern foundries. By carefully economising the men's time and by seeing that there is no wasted effort through repetition and doing unnecessary kinds of work, from which little benefit would be derived, it is confidently believed that in two years as much or more skill and experience can be given than young men would get in a commercial shop in a long apprenticeship. And if they have already had a considerable amount of practical experience —then this practical training, added to what they already have, will be of an advanced character and will enable them to take up grades of work that would come entirely outside the range of ordinary experience.

(2) *Text-book Study, Reading and Recitations, Practical Talks and Lectures.*—A great deal of the kind of some classes of information can be successfully and rapidly imparted through reading and study and by lectures and practical experiments and demonstrations given to a class of mature and earnest students by an experienced teacher. The plan includes a systematic course of this kind extending through each of the two years of the course.

(3) *Drafting and Design.*—The third important sub-division in the course includes a variety of training given on the drawing-board. There are many problems that can be solved better with drawings than in any other way; and a foundry leader of the type that I am trying to describe must have facility with his lead pencil and ability to express his ideas on paper, to sketch the things that he wants done, and to design the details of foundry appliances and foundry equipment, if he is to get the best results. We are making provision for training along this line.

(4) *Rapid and Accurate Computations.*—A knowledge of plain mathematics is necessary in the foundry business. The computations that are required include not only estimates of costs and quantities of material but also a great variety of calculations involving the use of formulas and more or less advanced mathematics. A systematic course of instruction is therefore planned, involving computations of just this kind, including such branches of mathematics as are essential. Care, however, is taken to omit text-book subjects that do not find daily application in the foundry industry.

(5) *Applied Science.*—The fifth principal subdivision of this new course of instruction is planned to cover all those principles of applied science which enter into the foundry industry, and general principles of engineering, such as steam generation, power transmission, applications of electricity and compressed air, strength and stiffness of materials, etc., which every foundry manager must understand if he is to become a leader of the type that we have been discussing. We regard this feature of the course as extremely important and are giving a considerable amount of time to it. We have a special laboratory equipped for this kind of work, and the students in the new course will be drilled, through lecture and recitation and through experiments in the laboratory, in all of these departments of applied science.

(6) *Foundry Chemistry.*—Perhaps the most original part of the work, so far as school practice is concerned, is the instruction that has been planned in foundry chemistry and chemical and metallurgical engineering, including, of course, the questions of combustion and the effects of temperature. The importance and value of this part of the work alone would require a special article. We have three laboratories devoted to this part of the work.

(7) *Scientific Management.*—Space will not allow a description of all the details, as they have been worked out, but there is one other point that ought to be mentioned. Leadership is a quality we certainly want to develop. It can be developed like any other quality, through practice, and therefore we have definitely planned to give the students in this new course opportunity to obtain systematic experience both in planning work and in directing the work of others. They will be expected to act as foremen supervising, first small operations, and as they gain experience, assuming larger and larger responsibilities.

Our experience in other courses has demonstrated that this kind of foremanship training does develop the qualities of initiative, and qualities of resourcefulness, courage and self-confidence which, taken together, we call leadership.

DRESSING FOR MOULDS FOR STEEL CASTING.—A method of dressing moulds for steel casting, which has been patented by J. C. Davis, abolishes the common practice of applying a wash consisting of a carbon-containing material, sand, and binder, in the use of which, he claims, the combustion of the carbon gives off a gas which is prevented from escaping and which lies naturally against the face of the mould, causing rough castings. He substitutes a mixture of a carbonaceous material such as 80 per cent. ferro-manganese, silica moulding sand, and linseed oil, combined in substantially the following proportions :—1½ lb. ferro-manganese, ½ lb. moulding sand, and ½ pint linseed oil. These, when thoroughly mixed, are claimed to form a plastic substance suitable to apply to the mould.

Trade Talk.

HEAVY damage was caused by a fire at Messrs. Dennis's Copper Works, Widnes

JUDGE WILLIAM H. MOORE has resigned as a director of the United States Steel Corporation.

THE CRYSTAL PALACE SCHOOL OF ENGINEERING is for the future to be carried on in private premises outside the Palace.

MESSRS. H. DEWHURST AND W. V. DEWHURST, founders, Warren Street, Sheffield, trading as Dewhurst Bros., have dissolved partnership.

THE average price of Scotch warrants during March was 94s. 0½d., which compares with 97s. 1½d. in February, 85s. 10d. in January, and 62s. in January, 1915.

THE workmen and staff of the Jarrow and Hebburn establishments of Palmers Shipbuilding & Iron Company, Limited, have now contributed £10,821 14s. 9d. to war relief funds.

BEFORE a meeting of metallurgists and foundrymen at the Mappin Hall, Sheffield, Mr. F. C. Thompson, of the Sheffield University staff, read a paper on "Some Electrical and Magnetic Properties of Iron and Steel."

THE TEES BRIDGE IRON COMPANY, LIMITED, is being wound up voluntarily, with Sir Frank Brown, of Stockton-on-Tees, as liquidator for the purpose of the sale of the undertaking to Pease & Partners, Limited.

MR. D. H. MCDOUGALL, who has been employed in various capacities in connection with the Dominion Iron and Steel and Dominion Coal Companies, has been appointed general manager of the Dominion Steel Corporation.

THE MINISTRY OF MUNITIONS announces that Captain Sir Henry Norman, Bart., M.P., has been appointed Liaison Officer between the Munitions Inventions Department in London and the French Bureau of Munitions Inventions in Paris.

NAYLOR, BENZON, & COMPANY, LIMITED, iron, metal, and ore merchants, 20, Abchurch Lane, London, E.C., have disposed of their interests in the Berkshire Iron Works, Sheridan, Pa., U.S.A., to Messrs. E. J. Lavino & Company, Bullitt Building, Philadelphia.

THE partnership between Mr. Archibald Gray and Mr. James Caldwell, trading as Gray & Caldwell, brassfounders, McGown Street, Paisley, has been dissolved by mutual consent. The business will be continued under the same name by Mr. James Caldwell.

THE No. 1 furnace at the Solway Ironworks at Maryport, belonging to the Workington Iron & Steel Company, Limited, was lighted on April 8. These works have been idle for nearly two years. Active preparations are also being made for the lighting of a second furnace.

MR. LLOYD GEORGE has informed Mr. Annan Bryce that as the Government had reason to believe that the Registration of Firms Bill would not be accepted as a non-contentious measure they were not, as at present advised, prepared to proceed with the Bill in the House of Commons.

MR. CHARLES JOHN MUNRO, 50, Frederick Street, Edinburgh, judicial factor on the estate of the deceased George Dick Reid, ironfounder, Halmyre Street, Leith, intimates that he has prepared and lodged in Court a statement of funds and scheme of division of the estate to be considered and approved of by the Court.

A PUBLIC lecture (without fee) will be given at University College (University of London), Gower Street, W.C., on May 15, at 5.30 p.m., on "The Manufacture of Nitrates from Air by Electric Power," by E. Kilburn Scott M.I.E.E., A.M.Inst.C.E. This is one of a series by different lecturers for the 1915-16 term.

THE ascertained selling price of No. 3 Cleveland G.M.B., for the first quarter of 1916 is 72s. 11.29d., as compared with 67s. 4.16d. in the last quarter of 1915, an increase of 5s. 7.12d. This gives an advance to the blast furnacemen, under the sliding scale, of 7 per cent., raising wages from 44 per cent. to 51 per cent. above the standard.

MR. F. DYSON, iron merchant and broker, of Middlesbrough, has retired from business. The business has now been transferred to a private company, Dyson, Jones & Company, Limited. While Mr. Dyson retains a financial interest in the concern, the sole management will be in the hands of Mr. Bernard Jones, who has been with Mr. Dyson over twenty years.

THE quarterly ascertainment under the sliding scale in force in the hematite iron-producing district of the North-West of England, shows that the average selling price of hematite pig-iron warrants was 115s. per ton, and the blastfurnacemen's wages have risen by 7 per cent., to a record of 93¾ per cent. above the standard. There was not a single alteration in the quotation of warrants during the quarter.

THE work of the Ontario Nickel Commission, which was temporarily suspended owing to the absence of two members, has now been resumed, visits having been made to Birmingham, Sheffield, and other steel producing centres. Attention is being given to other products of the Cobalt and Sudbury mines, in addition to nickel, particularly as the utilisation of cobalt is finding favour in the electro-plating industry in this country.

THE firm of J. Miller Reid & Sons, carrying on business as brassfounders and coppersmiths, at Lancefield Street, Glasgow, has been dissolved, by mutual consent, by the retiral therefrom of John Reid. The business is being continued by J. Miller Reid, David Reid and Andrew Reid on their own account and under the same firm name. John Reid will continue to carry on the business of brassfounders at 43, Oxford Street, Glasgow, under the name of the Reid Brass Castings Company, of which he is the sole partner.

THE next meeting of the Institution of Automobile Engineers will be held in the Hall of the Royal Society of Arts, John Street, Adelphi, W.C., on Wednesday, May 10, when Mr. L. H. Pomeroy will read a paper, entitled "The E. S. C. Standard Steel Specifications." The standard specifications for automobile steels which are now being issued by the Engineering Standards Committee, were drawn up by the Steels Committee of the Institution, of which Mr. Pomeroy is chairman, and this paper will set forth the reasons of the committee for the adoption of the steels and their application in automobile construction.

A LECTURE on the "Precipitation of Free Carbon in Iron and Steels" was given by Dr. W. H. Hatfield, at a meeting of the Cleveland Institution of Engineers, held at Middlesbrough on April 17. Colonel Hawdon, who presided, said it was interesting to note in connection with the scheme for the establishment of a research laboratory for Middlesbrough, that in Sheffield all the works chemists were drawn from Sheffield University. Sheffield was a long way ahead of Middlesbrough in that respect, and it was necessary that the latter town should have the facilities for higher education that a big laboratory and school would afford.

DR. ADDISON, replying to Mr. Field in the House of Commons last month, stated that the number of persons engaged on Government work in the metal and chemical trades, including those employed at the ordnance factories, is approximately 1,900,000, of whom over 200,000 are women and girls. Of this total from 40 per cent. to 45 per cent. are engaged on Admiralty work, while a comparatively small proportion of the remainder are working for the Contracts Department of the War Office on non-munition work. These persons are employed in approximately 13,000 factories and workshops, in addition to the ordnance factories, but a number of these concerns are only partially employed on Government work.

MR. RUNCIMAN writes in reply to MR. NIELD:—Bohler Bros., of Sheffield, is a branch of the Austrian firm of Bohler Bros. & Company, which has its head office in Vienna and branches in Germany. I have no information as to what is being done at the works in Austria. The manager of the branch in Sheffield was abroad at the outbreak of the war, and has not returned. The present manager is a British subject, and I am not aware that the engineering trade in this country is being deceived as to the constitution of the business or the nature of the steel purchased from the firm. I

will refer the case to the Advisory Committee to consider the application of the provisions of the Trading with the Enemy Amendment Act, 1916, as soon as they are able to deal with it.

A NEW regulation has been added to the Defence of the Realm (Consolidation) Regulations, 1914, providing that any person "charged with having in his possession or under his custody or control any tungsten, or tungsten ore or products therefrom, high-speed steel or scrap therefrom, molybdenum, vanadium, cobalt, nickel, or any alloy used in the manufacture of high-speed steel, or any other metal required for the production of war material for the time being specified in an Order made for the purpose by the Admiralty or Army Council or the Minister of Munitions, which may be reasonably suspected of being stolen or unlawfully obtained or acquired, who does not give an account to the satisfaction of the Court how he came by the same, shall be guilty of a summary offence against these regulations."

CONSIDERABLE progress is being made by the Joint Committee, which is composed of representatives of the Admiralty, War Office, Royal Aircraft Factory, Aircraft Steelmakers' Committee, Iron and Steel Institute, Institution of Automobile Engineers, and the Society of Motor Manufacturers and Traders, Limited. The investigation is being conducted to establish the physical properties of the standard automobile steels, and the factors governing testing procedure in connection therewith. Offers of steel gratis have already been received from :—Cammell, Laird & Company, Limited, W. Beardmore & Company, Limited, Brown, Bayley' Steel Works, Limited, D. Doncaster & Company, W. T. Flather, Limited, T. Firth & Sons, Limited, Hadfields, Limited, Steel, Peech & Tozer, Limited, Sir J. Jonas, Colver & Company, Limited, and Vickers, Limited. The majority of these offers have been provisionally accepted. Kayser, Ellison & Company, Limited, have undertaken to do any rolling required.

THE MONOMETER MANUFACTURING COMPANY, LIMITED, Whitehouse Street, Aston, Birmingham, inform us that the Monometer patented furnaces, melting furnaces, hardening furnaces, and heat controllers are in great demand for war work for the melting of lead, Admiralty metal, aluminium, tin, zinc, &c., and installations have recently been made in the following well-known establishments :—The Great Western Railway; Robey & Company, Limited; J. Hinks & Son, Limited; Joseph Lucas, Limited; the Waltham Ironworks, Limited; the Thames Smelting & Refining Company; Claughton Brothers, Limited; the Lead Wool Company, Limited; Tweedale & Smalley, Limited; Connolly Brothers, Limited; Richards Plastic Metal Company, Limited; J. & H. B. Jackson; Jones & Company; W. Branfield, Meadow Works, Sheffield; H. B. Sale, Limited; Belotti & Company; Bell & Company; Lea & Company, Limited; J. & J. Hughes; and the Leading Light Syndicate, Limited.

MR. W. R. BUCKINGHAM, secretary of the Machinery Users' Association, calls attention to the incidence of the taxation of controlled establishments. Under the Budget resolutions of the 4th inst. the Treasury will recognise payment of munition levies, but if the amounts are less than would be payable under the new Budget the difference will have to be made up in cash. Mr. Buckingham writes that under the Budget a firm will pay 60 per cent. of the excess profit. In order that the amount payable under the Munitions Act shall be equal to the tax under the Finance Act the profit will have to be 50 per cent. more than the standard. The firm will then be entitled under the Munitions Act to 40 per cent. of the excess (which would be equal to 20 per cent. of the standard), and the Government would claim the remaining 60 per cent. of the excess. Where, however, the excess profit is less than 50 per cent. of the standard the firm will be called upon to hand over 60 per cent. to the Government and retain the remainder. Take a standard of profit of £10,000 and an excess profit of £2,000. Under the Munitions Act the firm would pay no duty, but under the new Budget they would pay 60 per cent. of the £2,000.

Scientific and Industrial Research.

In order that the Advisory Council for Scientific and Industrial Research may be in a position to do justice to the branches of industry concerned in proposed researches of great importance which have been submitted to the council by institutions and individuals, it has been decided to appoint Standing Committees of experts. We are officially informed that the following arrangements have been made :—Strong committees in mining and metallurgy have already been constituted, consisting both of scientific men and of leaders of the industries concerned. The mining committee will have two sections, dealing respectively with the mining of non-metals and the mining of metals. Sir William Garforth has accepted the chairmanship of the committee and of the non-metals section, and Mr. Edgar Taylor, of the firm of John Taylor and Sons, has accepted the chairmanship of the metals section. The Metallurgy Committee will also have two sections, dealing in this case with ferrous and non-ferrous metals respectively. Sir Gerard Muntz, of Muntz's Metal Company, Limited, has accepted the chairmanship of the committee and of the non-ferrous section, and Sir Robert Hadfield, F.R.S., of Hadfields, Limited, has accepted the chairmanship of the ferrous section. The Advisory Council hopes at an early date to constitute a similar committee for engineering.

Up to the present the council has been engaged in work which is mainly initiatory and preparatory in character. For example, in order that investigations already in progress should so far as possible be carried on in spite of the war, scientific and professional societies were invited to submit applications for aid to continue researches for which the necessary staff and equipment were obtainable. Grants have already been made, or will shortly be made, to the Institution of Mechanical Engineers (hardness tests and the properties and composition of alloys), to the Institution of Electrical Engineers (heating of buried cables and the properties of insulating oils), to the Institute of Chemistry (laboratory glass and optical glass), to the Institution of Mining and Metallurgy (methods of extracting tin and tungsten), to the Institute of Metals (corrosion of non-ferrous metals), to the Institution of Gas Engineers (refractory materials), to the Manchester Association of Engineers (tool steel experiments), and to the National Physical Laboratory (optical glass). Other proposals of the same type are still under consideration. Timely and valuable results have been quite recently obtained from the researches carried out by Professor Herbert Jackson under the auspices of the Institute of Chemistry and from the researches carried out at the National Physical Laboratory by Dr. Rosenhain. The Advisory Council has also recommended a grant in aid of an important new research into the manufacture of hard porcelain, especially for domestic purposes. This has been undertaken by the Governing Body of the Stoke-on-Trent Central School of Science and Technology, in conjunction with the Staffordshire Potteries Manufacturers' Association.

Particulars have been obtained of the research work, not only of the Scientific and Professional Societies, but also of the universities and higher technical schools, with a view to the establishment of a register of research. The possibility of proceeding to collect in the near future information under seal of confidence as to the research work of particular firms is also being considered.

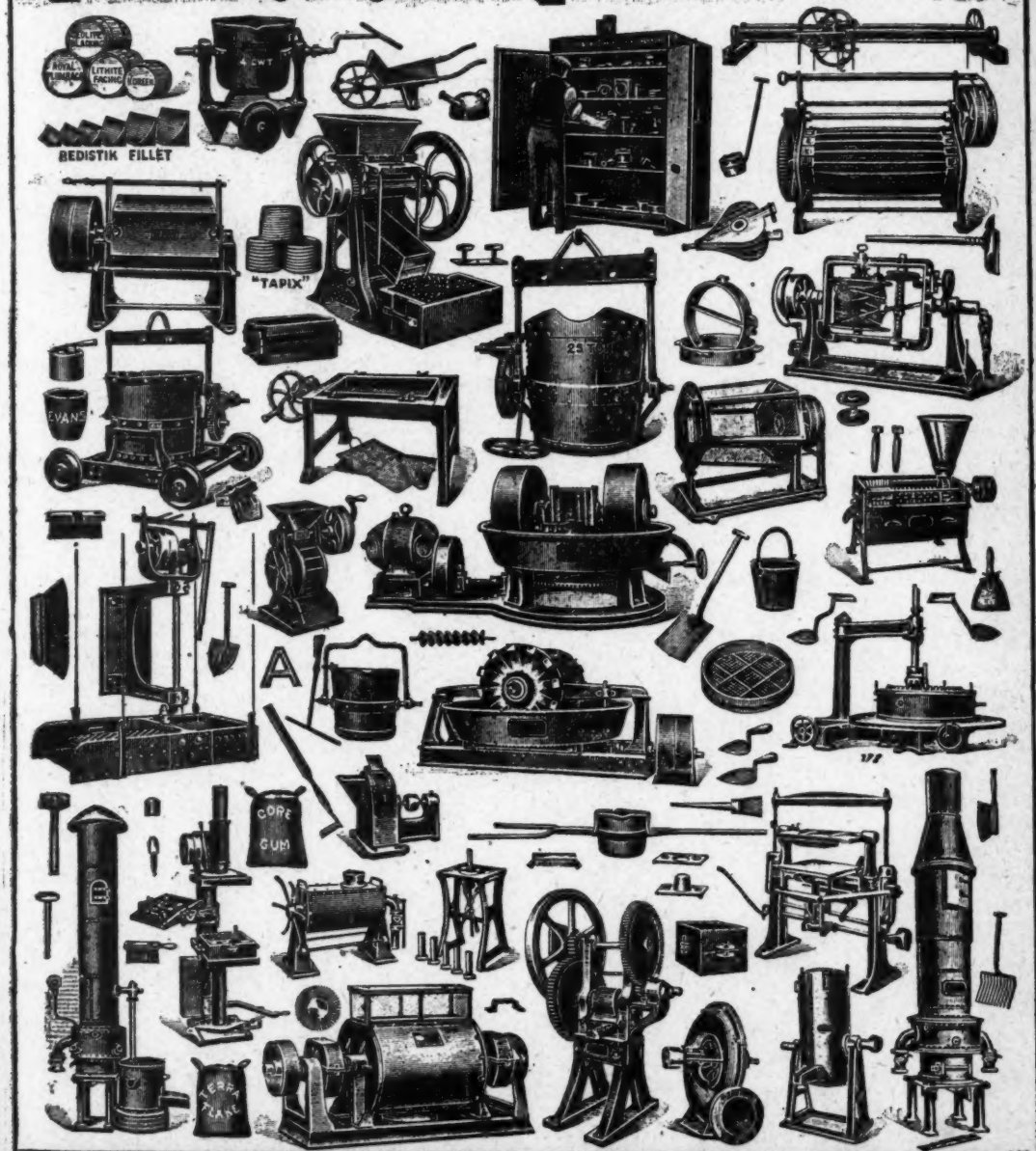
The training of an adequate supply of research workers will be an important branch of the Advisory Council's work, and the steps to be taken for that purpose will require much careful thought. It is impossible to announce definite plans during the war, but the Advisory Council is so much alive to the urgency of the matter that it has thought it necessary to take immediate interim action, and has, therefore made recommendations which, if adopted, will, it is believed, secure that all that is practicable in existing circumstances shall be done.

COMPLETE

Foundry Equipment.

Telegrams: "LADLES MANCHESTER"

Telephone: "No. 2297 CENTRAL" MANCHESTER.



JAMES EVANS & Co. BRITANNIA WORKS, BLACKFRIARS, MANCHESTER.

Deaths.

Mr. G. J. Evered, managing director of Evered & Company, Limited, died recently at the age of 54 years.

The death is announced of Mr. Thos. Coulson, who for a period of 35 years was cashier and secretary of the Birtley Iron Company, Limited.

The death is reported of Mr. T. W. Lindley, manager of the steel department of Messrs. Leadbeater & Scott, Sheffield, whom he had served for thirty-seven years.

Mr. E. Martin Player, of Clydach, second son of Mr. and Mrs. John Player, J.P., of the firm of Messrs. John Player & Sons, tinplate manufacturers, of Clydach and of Cheltenham, has died after a very short illness.

Sec.-Lieut. T. O. H. Bates, late chief electrical engineer to the Tata Iron & Steel Company, Limited, Bombay, India, died on April 12 of wounds received in action. Prior to his appointment in India he held the position of engineer-in-charge at the Morley Corporation Electricity Works and also as electrical engineer at the Rotherham Main Collieries.

The death has occurred, at the age of 73 years, of Mr. E. Reddish, of Red Croft, Edwinstowe, who had been in failing health for some time. Before retiring from business, ten years ago, he was managing director of Gregory, Reddish & Company, Limited, of Deepcar. He was a member of the Iron and Steel Institute, and was for many years a member of the firm of Grayson Lowood & Company, Limited, Deepcar.

Mr. John Spencer, commercial manager for Messrs. John Blumer & Company, shipbuilders and shiprepairers, North Dock, Sunderland, for nearly 30 years, has died at his residence, 18, Roker Park Road, Sunderland. Mr. Spencer, who was born at Ipswich 62 years ago, went to Sunderland 37 years since to take up employment with Messrs. Blumer, and his connection with that firm remained unbroken up to the time of his death.

Captain H. S. Chamberlain, whose name has been identified with the iron industry of the Southern United States for nearly half a century, died at Chattanooga, Tenn., recently. He was connected with the company which had the first coke furnace in the South, and later experimented with the Danks rotary puddling furnace and installed ten of them. He was a member of the Iron and Steel Institute, and always welcomed English visitors in his district.

The death has occurred of Mr. J. M'Ewan Herdman, of Ramsay Lodge, Trinity, Edinburgh. Mr. Herdman, who was 59 years of age, was, until recently, a managing director of the firm of Hawthorns & Company, Limited, shipbuilders and engineers, Leith. He served his engineering apprenticeship with Messrs. S. & H. Morton & Company, of Leith. After experience with Messrs. Victor Coates & Company, in Belfast, as manager, he joined the firm of Hawthorns & Company, in 1885, from which he retired in 1914. During the past few years he had occupied himself with advising and consulting engineering.

Mr. J. Tweedy, of Tritlington Hall, Morpeth, one of the best known engineers on the North East Coast, died on April 7. Mr. Tweedy's early training as an engineer was with Messrs. Richardson, Westgarth and Company, West Hartlepool, and he was afterwards with Messrs. George Clark & Company, Southwick, Sunderland. Many years ago he became associated with Wigham Richardson, Limited, Neptune Works, Walker, and he had a great deal to do with the prosperity of this company, of which he was a director. Upon the amalgamation of this company with Messrs. Swan and Hunter, he also occupied a seat on the directorate of the new company, now known as Swan, Hunter & Wigham Richardson, Limited. He was regarded as a most capable engineer, and was identified with the Yarrow-Schlick-Tweedy balanced reciprocating engine. In the years 1902-3-4 he was president of the North East Coast Institution of Engineers and Shipbuilders.

Personal Paragraphs.

Sir John S. Randles, M.P., is to be made a freeman of the Borough of Workington.

Mr. Henry Westlake has resigned his seat on the board of Cammell, Laird & Company, Limited.

Mr. W. H. Rudge has been elected managing director of Fletcher, Russell & Company, Limited, Warrington.

Estate of the value of £44,001 has been left by the late Mr. Herbert Beesley, late managing director of W. T. Beesley & Company, Limited.

Mr. T. S. Hunter, consulting engineer, 14, St. Mary Axe, E.C., has been elected a director of Dudgeon & Gray, Limited, consulting engineers and naval architects, of 89, Aldgate, London, E.

Mr. G. Gummer, of Rotherham, Chairman of the Employers' Brass Founders' Association, has been the recipient of a presentation from the members in recognition of his voluntary services for the last eighteen years.

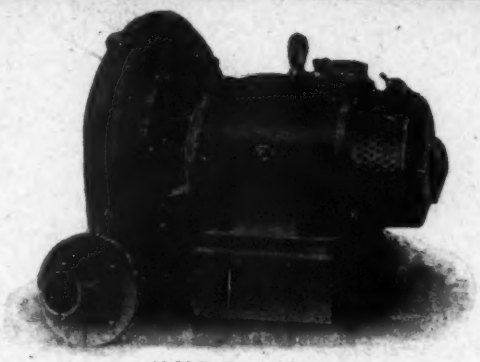
Mr. H. B. Rowell has been re-elected president of the North-East Coast Institution of Engineers and Shipbuilders, and Mr. R. H. Winstanley, treasurer, with Dr. G. B. Hunter, Mr. D. B. Morison and Mr. E. L. Orde as vice-presidents. Sir Philip Watts and Messrs. F. T. Dickinson, Hewitson Hall and Thos. Putnam have been re-elected members of the council.

Captain H. H. Jackson, commander of "G" (Clay Cross) Company of the 6th (Territorial) Battalion of the Sherwood Foresters, Notts, and Derbyshire Regiment, the second son of Colonel G. M. Jackson, has been the recipient of gifts from the staff of the company on attaining his majority. Colonel Jackson is the managing-director of the Clay Cross Company, Limited.

The council of the Institution of Civil Engineers have made the following awards for papers read and discussed during the session 1915-16:—A Telford gold medal to Sir John Penton (Eastbourne), a Watt gold medal to Sir George Buchanan (Rangoon), a George Stephenson gold medal to Mr. F. W. Carter (Rugby), and Telford premiums to Mr. C. C. James (London), Mr. D. E. Lloyd-Davies (Cape Town), and Mr. W. T. Lucy (Oxford). Awards for papers published in the proceedings without discussion will be announced later.

Mr. Philip Kirkup, a newly-elected member of the Institution of Civil Engineers, went to Birtley about 20 years ago as chief mining engineer to the Birtley Iron Company's group of collieries. The extensive foundry and engineering works were subsequently placed under his control, and he now acts as general manager for the whole of the company's departments. From the first Mr. Kirkup introduced improvements and modernised all the collieries under his charge. Besides carrying out important engineering schemes on the railways, etc., he has quite recently completed a large plant at the Birtley "E" pit for the generation of electric power with transmission supplies to the other collieries.

The five-year term of office of the Marquis of Bristol as President of the Institution of Naval Architects having come to an end with the close of the past session, the council invited the Earl of Durham to succeed Lord Bristol. The Council have also elected Sir Philip Watts, Engineer-Vice-Admiral Sir John Durston, Admiral Sir Henry Jackson, Mr. H. J. Cornish, Mr. R. H. Humphrys, and Mr. J. T. Milton, as honorary vice-presidents of the Institution. The new vice-presidents elected are: Mr. Thomas Bell, Engineer-Rear-Admiral G. G. Goodwin, R.N., and Messrs. J. Foster King, Andrew Laing, E. H. Tennyson D'Eyncourt, C.B., and W. H. Whiting; the members of council re-elected or newly elected are: Sir James Williamson, and Messrs. W. D. Archer, R. R. Bevis, James Brown, P. T. Caird, P. A. Hillhouse, W. W. Marriner, D. B. Morison, A. W. Sampson, R. L. Scott, J. Smith, C. E. Stromeyer, J. E. Thornycroft, W. Weir; and as associate members of council: the Marquis of Graham, Sir Alfred A. Booth, Bart., and Mr. J. M. Falkner.



10 H.P. Fan and Motor.

TRADE SIROCCO MARK

High Pressure Fans

Are made in a large number of sizes from 10 in. diameter upwards.

Bulletins 2000 F. and 2028 F.

Some Points worth noting.

Owing to few wearing parts, the Fans are not liable to break down. The mechanical efficiency is high and remains so. The pressure is steady and the volume even and free from pulsations.

Davidson & Co., Ltd.,

Sirocco Works,
BELFAST.

USE

FERRO CARBON TITANIUM

TPC BRAND

For Sound Steel and Iron Castings.

T. ROWLANDS & Co., Ltd.
SHEFFIELD.

British & European Agents for:
TITANIUM ALLOY COMPANY.
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DELIVERIES FROM STOCK.

IRON CASTINGS.
"FOUNDRY GRADE."
STEEL CASTINGS.
"E GRADE."

Organised Scientific Effort.

A conference convened by the President and Council of the Royal Society has been held at Burlington House to consider the desirability of establishing a Conjoint Board of Scientific Societies for the purpose of organising scientific effort in this country. Delegates from the following societies attended to confer with the President and Council of the Royal Society: Royal Society of Edinburgh, Royal Society of Arts, Royal Anthropological Institute, Royal Astronomical Society, Royal College of Physicians, Royal College of Surgeons, Royal Geographical Society, Royal Institution, Institution of Civil Engineers, Institution of Electrical Engineers, Institution of Mechanical Engineers, Institution of Mining Engineers, Institution of Naval Architects, Institute of Chemistry, Society of Chemical Industry, British Association, Chemical Society, Geological Society, Linnean Society, London Mathematical Society, Physical Society, Physiological Society, and the Zoological Society.

The following resolution was passed unanimously, and a committee was appointed to draft a scheme for giving effect to the resolution and to report thereon to a future meeting:

"This meeting considers that it is desirable to establish a Conjoint Board of Scientific Societies for the purpose of (1) Promoting the co-operation of those interested in pure or applied science; (2) supplying a means by which the scientific opinion of the country may, on matters relating to science, industry, and education, find effective expression; (3) Taking such action as may be necessary to promote the application of science to our industries and to the service of the nation; (4) Discussing scientific questions in which international co-operation seems advisable.

Applications for Patents.

Tricot, G. L. Soldering or brazing aluminium and other metals or alloys. 2017. Feb. 10.
Ballan, H. Metallic alloy. 2169. Feb. 14.
Hall, I. Furnaces of the tilting type. 2214. Feb. 15.
Hall, I. Shell-drying ovens and trucks. 2215. Feb. 15.
Hall, I. Crucible, &c., melting furnaces. 2487. Feb. 19.
Kanovitch, H., & Rinberg, D. Metallic alloy. 2169. Feb. 14.
Carbin, T., & Paton, J. D. Production of metal castings. 2784. Feb 24.
Hope, J. A. Furnaces. 2998. Feb. 26.
Brearley, H., and Melmoth, F. A. Manufacture of alloy steels or ferro-alloys. 3091. March 4.
Etchells, H., and Greaves, H. A. Electric furnaces. 3067. March 1.
Keith, G. and J. Apparatus for controlling mixture supplied to gas-fired furnaces. 3181. March 2.
Stobie, V. Method of reducing electrode consumption in electric steel-melting furnaces. 3068. March 1.
Balmforth and Co., T., and Kitchen, H. J. Electric furnaces, etc. 3598. March 10.
Berry, F. L., Wilson, A. K., and Spear and Jackson. Casting steel ingots. 3578. March 10.
Hall, I. Furnaces. 3499. March 9.
Jones, A. B. Couplings for railway, etc., wagons. 3492. March 9.
Perry, F. L., Wilson, A. K., Gordon, F. F., and Spear & Jackson. Apparatus for casting steel ingots, &c. 3910. March 16.
Bithrie, N. G., and Higginson, G. S. Die-casting metals, alloys, &c. 4070. March 18.
National Malleable Castings Co. Chains. 3997. March 17. (United States, March 20, 1915.)
Hyde, J. R. & R. Casting steel, etc. 4371. March 24.
Jack, A. Apparatus for handling ingots, tipping-boxes, etc. 4435. March 25.
Radcliffe, F. Moulding-machines for metals. 4148. March 21.
Hall, I. Crucible furnaces. 4764. March 31.
Jenkinson, H. G., & Winder, B. W. Testing hardness of steel, etc. 4652. March 30.
Lake, W. B., Sharpe, D., & Moscrip, W. Foundry ladles. 4831. April 1.
Romanes, J. S. Electric furnaces for smelting and refining metals. 4479. March 27.
Barclay, W. R., Stone, G. E. M., and Fairholme, F. C. Pyrometers for metallurgical operations. 4855. April 3.
Price, S. W. Tilting furnaces. 5139. April 7.
Talbot, B. Manufacture of steel or ingot iron. 4996. April 5.

New Companies.

West London Engineering Company, Limited.—Capital £10,000 in £1 shares.

Barclay Engineering and Manufacturing Company, Limited.—Capital £3,000 in £4 shares.

Standard Shipbuilding & Engineering Company, Limited.—Capital £300,000 in £1 shares.

Marcus Allen & Sons, Limited.—Capital £10,000, in £1 shares, to carry on the business of engineers.

Dee Engineering Company, Limited.—Capital £600 in 500 £1 preference shares, and 2,000 1s. ordinary shares.

Swindell & Company, Limited.—Capital £10,000 in £1 shares (4,000 6 per cent. cumulative preference), to carry on the business of ironfounders.

L. C. Rawlence & Company, Limited.—Capital £20,000 in £1 shares, to carry on the business of engineers. Registered office 39, Sackville Street, W.

A. E. Beard & Company, Limited.—Capital £3,000 in 60,000 1s. shares, to carry on the business of engineers, &c. Registered office:—97, Upper Kennington Lane, London, S.E.

Stockport Furnaces (Stockport), Limited.—Capital £2,000 in £1 shares, to carry on at Stockport, Birmingham, or elsewhere the business of furnace makers and dealers, etc.

The Associated Engineers, Limited.—Capital £1,000 £1 shares, to carry on the business of electrical, motor, and general engineers, etc. The first directors are J. Rhodes, Bradford, and J. R. Pepper, Shipley.

Goldendale Iron Company, Limited.—Capital £40,000 in £1 shares, to acquire the business of blast furnace proprietor and ironmaster carried on by H. H. Williamson at Chattersley, near Tunstall, Stoke-on-Trent.

Walter Robb, Limited.—Capital £10,000 in £1 shares (9,000 A and 1,000 B), to take over the business of an electrical engineer carried on by W. Robb, at Wakefield. The first directors are W. Robb and H. F. Buttenshaw.

W. M. Lester & Sons, Limited.—Capital £6,000 in £1 shares, to take over the business of iron and steel manufacturers and merchants carried on at the Bradford Ironworks, Walsall. Registered office: Bridgeman Street, Walsall.

Dexter Engineering Company, Limited.—Capital £5,000, in £1 shares (4,000 6 per cent. cumulative preference), to take over the business carried on by D. Hazel, as the Dexter Engineering Company. Registered office: 14, Nile Street, City Road, London, E.C.

Martino's Treating and Testing Works, Limited.—Capital £15,000 in £1 shares, to carry on the heat treating, testing, analysing, and case-hardening of steel and other materials, etc. The first directors are E. B. Martino, M. Hudson, H. Miller, J. H. Doncaster, C. M. Doncaster, and B. W. Doncaster.

Fletcher, Miller, Limited.—Capital £500 in £1 shares, to acquire from J. A. Fletcher and others the business of manufacturers of cutting and case hardening compounds for ferrous and non-ferrous metals. Registered office:—82, Bentinck Street, Ashton-under-Lyne.

Walsall District Iron Company, Limited.—Capital £20,000 in £1 shares, to take over the business of iron and steel manufacturers and merchants carried on at the District Ironworks, Walsall, as the Walsall District Iron Company. Registered office: Birchills Street, Walsall.

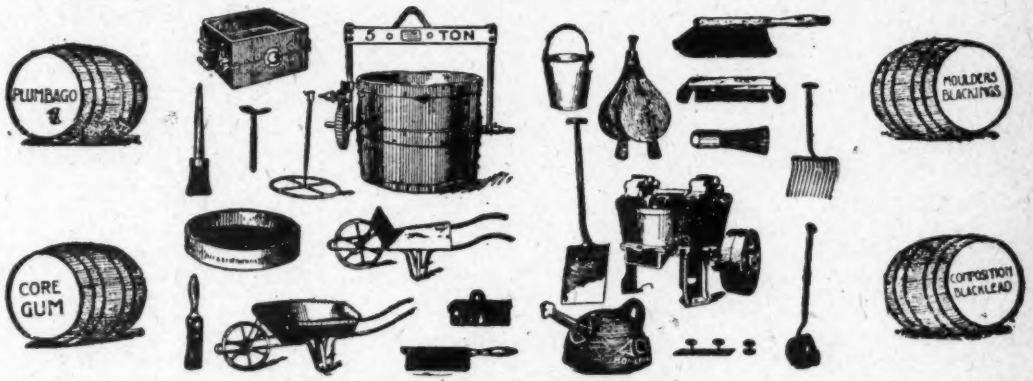
Alfred Danks, Limited.—Capital £2,000 in £1 shares, to establish and carry on the business of ironfounders, mechanical, electrical, and general engineers, etc. The first directors are A. Danks, Frogcastle, Sandhurst Road, Gloucester; E. H. Summers, Llanthony, Gloucester.

Henry Righton & Company, Limited.—Capital £1,000, in £1 shares, to take over the business carried on at Balfour House, 119-125, Finsbury Pavement, E.C., as Henry Righton & Company, to carry on the business of founders, engineers, &c. The first directors are A. H. Hughes, A. W. Johnson, and H. J. Shelley. Registered office: 15, Coleman Street, E.C.

Established 1863.

JAS. DURRANS & SONS,

Phœnix Works, Penistone, Near Sheffield.



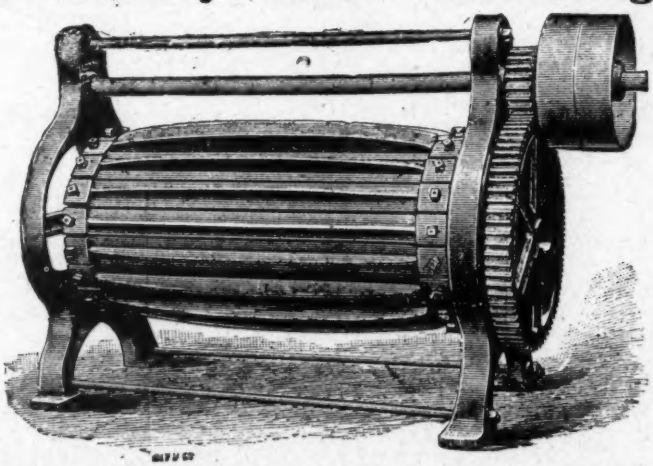
Manufacturers of all

FOUNDRY EQUIPMENTS

COMPOSITION BLACK LEAD, PLUMBAGO, CORE GUM, WHITE DUST & COAL DUST

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

Improved Foundry Rattler or Fettling Drum.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

The following testimonial explains itself :—

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD.

MONTHLY PRICE LIST.

The undermentioned prices, unless otherwise specified, are those obtaining at the commencement of the current month.

CONTROL PRICES.

These maximum prices of iron, steel and coke have been fixed by the Government until June 30, 1916, and thereafter until further notice. Makers may sell for delivery after June 30, on the understanding that the fixed maximum prices ruling on the 1st day of any month during the period of the contract will apply to all deliveries made during that month. This intimation must not be taken to authorise any sale or purchase or other dealing prohibited under the Defence of the Realm Regulations.

Pig-Iron.

	£	s.	d.
West Coast hematite, mixed Nos., 1, 2 and 3	6	7	6
Special under 0.03 P & S	6	15	6
„ „ 0.02 „	7	0	0
East Coast hematite, mixed Nos. 1, 2 and 3	6	2	6
Special under 0.03 P & S. ..	6	15	6
„ „ 0.02 „	7	0	0
Scotch hematite, mixed Nos., 1, 2 and 3..	6	2	6
Special under 0.03 P. & S. ..	6	15	6
„ „ 0.02 „	7	0	0
Welsh hematite, mixed Nos., 1, 2 and 3	6	2	6
Special under 0.03 P. & S. ..	6	15	6
„ „ 0.02 „	7	0	0
Lincolnshire, basic or foundry ..	4	7	6
Cleveland, mixed Nos. 1, 2 and 3..	4	2	6
Northamptonshire, forge	4	2	6
„ foundry numbers	4	5	0
Derbyshire, forge	4	5	0
„ foundry numbers ..	4	7	6
Leicestershire, No. 4 forge ..	4	5	0
„ No. 3 foundry ..	4	7	6
North Staffs, forge	4	10	0
„ „ foundry	4	12	6
„ „ basic	4	15	0
South Staffordshire—			
Part mine forge	4	10	0
„ foundry	4	12	6
Common Staffordshire ..	4	5	0
All mine forge	5	10	0
„ foundry	5	15	0
Warm air forge	7	0	0
„ foundry	7	10	0
Lord Dudley's silicon	7	17	6
Cold blast	8	17	6
Scotch foundry and forge—			
Nos. 3, 4, and lower grades of Monkland, Dalmellington, Eglinton, and Govan.. ..	5	14	0
Nos. 3, 4, and lower grades of all other brands	5	15	6

No. 1 quality in all cases to be 5s. per ton above these prices.

All per ton net, f.o.t. makers' works.

High-Speed Tool Steel.

The maximum prices for high-speed tool steel have been fixed as follows:—

Finished bars, 14% Tung. 2s. 10d.

Finished bars, 18% Tung. 3s. 10d.

Per lb. basis. Usual trade extras for special sizes, etc. These prices are net delivered buyers' works.

The fixed prices for scrap which must be returned to steel makers' works are as follows:—

Millings and Turnings	5d.
Bar Ends	6d.

Both per lb. net delivered steel makers' works

Ferro-Alloys

Net, Delivered Sheffield steel works.

	£	s.	d.
Ferro chrome: 4/6% carbon. Basis 60%, scale 10s. per unit Per ton	35	0	0
Ferro-chrome: 6/8% carbon. Basis 60%, scale 10s. per unit. Per ton	29	10	0
Ferro-chrome: 8/10% carbon. Basis 60% scale, 10s. per unit Per ton	28	0	0
Ferro-chrome: Specially refined, guaranteed maximum 2% carbon broken to small pieces for use in best quality crucible steels. Basis 60%, scale 32s. per unit. Per ton	86	0	0
Ferro-vanadium: 33/40% Va., per lb. of Va. contained in the alloy	0	15	0
Ferro-silicon: 45/50%. Basis 50%, 5s. scale per unit .. Per ton	28	10	0
Ferro-titanium: 23/25%, per lb. carboniess	0	1	5
Ferro-molybdenum: 70/80% Mo. per pound of Mo. contained ..	0	18	0
Ferro-phosphorus: 20/25%. Per ton	16	10	0
Ferro-tungsten: 75% to 80% per lb. of metallic tungsten contained	0	6	1
*Ferro-manganese 80%	25	0	0
„ export 30 0 0—40	0	0	

* F.o.b. Liverpool.

Non-Ferrous Metals.

Copper.

	£	s.	d.	£	s.	d.
Standard, Cash	132	0	0	132	10	0
Three months	125	0	0	126	0	0
Electrolytic ..	142	0	0	145	0	0
Tough ..	136	0	0	138	0	0
Best selected ..	137	0	0	139	0	0

Tin.

Standard, Cash	198	0	0	198	5	0
Three months	197	0	0	197	5	0
English Ingots ..		—		206	0	0
Bars		—		207	0	0
Refined		—		210	0	0

Spelter.

American		—		108	0	0
Specials.. ..		—			—	
Hard		—		85	0	0
British		—		110	0	0

Lead.

Soft Foreign		—		34	11	3
English		—		35	15	0

Antimony.

Regulus		—		95	0	0

Aluminium.

Virgin Metal 98/99% per ton		—		155	0	0

Phosphor Bronze.

INGOTS.	Per ton.		
Alloy No. I. or II.	137	5	0
III., IV. or V.	136	5	0
VI. or VII.	138	5	0
VIII.	138	5	0
XI.	133	5	0
Cast Strips and Ingots.. ..	131	5	0

CASTINGS.	Per lb.		
I. or II.	0	1	5½
III. IV. or V.	0	1	6
VI. or VII.	0	1	6½
VIII.	0	1	6½
XI.	0	1	5½
No. VII., Chill, Cast, Solid ..	0	1	5½
„ Cored Bars	0	1	7

Delivery 2 Cwt. free to any town.

10 per cent. Phosphor Copper .. 35/- above price of best selected copper.

15 per cent. Phosphor Copper .. 40/- above price B.S.

Phosphor Tin (5 per cent.) .. £23 above Price of English Ingots.

(Phosphor-bronze prices supplied by CHARLES CLIFFORD AND SON, LIMITED, FAZELEY STREET MILLS, BIRMINGHAM).

*Chromium (Metallic).

98/99% purity, per lb.	—	0	5 9

*Nickel.

In cubes, 98/99% purity Per ton	220	0	0

Nickel Silver.

	per lb.
Ingots for raising	1/10 to 1/4
Ingots for Spoons and Forks ..	1/10 to 1/3½
„ rolled to spoon size ..	1/11½ to 1/5

*Tungsten Metal Powder.

96/98% purity.. per lb. ..	0	6	3

*Molybdenum Metal.

96/98% purity.. per lb. ..	—

*Cobalt Metal.

97% purity .. per lb. ..	0	8	0

Quicksilver.

75 lb. bottle	16	13	9

* Net, Delivered Sheffield Works.

Scrap Iron and Steel.

Cleveland.

	s.	d.		s.	d.
Steel scrap, heavy melting..	100	0	to	102	6
Iron scrap cast (cupola metal)	75	0		77	6

London (f.o.b.).

Heavy steel	90	0	
Light „	50	0	
Heavy cast	80	0	

Non-Ferrous Scrap.

London merchants quote the following prices for scrap metal, delivered London, and subject to market fluctuations:—

	A. Joseph. £	s.	d.
Hy. Electrolytic Copper Scrap ..	125	0	0
Hy. Selected Scrap Brass ..	82	0	0
Hy. Tinned Copper Wire	108	0	0
Best Selected Gunmetal Scrap ..	96	0	0

Re-melted Ingot Lead 20s. under English Lead price on date of order.

Stocks.

Metals.

	Tons.
Copper, Europe and afloat	14,907
Tin, London, Holland, U.S.A. and afloat	20,421

Coke.

Middlesbrough.

	s.	d.	s.	d.
Gas Coke	—		22	6

Cardiff.

	s.	d.	s.	d.
Special Foundry Coke ..	—		—	
Foundry Coke	—		—	

Glasgow.

Foundry Coke	35	0		36	0	
Furnace Coke	27	0		28	6	
Gas Coke	—			—		

London.

Welsh or Durham Foundry, d/d London Stations in truck	—	50	0
Ditto, d/d Birmingham Stations	—	46	6
Yorkshire, d/d London Stations, in truck	—	42	6
Ditto, d/d Birmingham Stations	—	39	0

CONTROL PRICES OF COKE.

	s.	d.
Durham blast furnace	28	0
„ special ditto, guarantee under 0.008 phos... ..	30	6
„ foundry	30	6
South Yorkshire, West Yorkshire, North Staffordshire, and North Derbyshire	24	0
South Wales blast furnace	30	0

All per ton net f.o.t. ovens.

SITUATIONS VACANT AND WANTED.

FOUNDRY FOREMAN, disengaged, used to all classes of work, light and heavy; green sand, dry sand; fair knowledge of loam; experience in non-ferrous metals; age 42.—Write, Box 602, Offices of *Foundry Trade Journal*, 165, Strand, W.C.

WANTED, a thoroughly experienced and qualified MAN to take charge of the working of gas producers at a large Steelworks. Must also have complete knowledge of gas analysis, and be well used to handling workmen. Reply stating age, qualifications, and remuneration required to Box 820, Offices of *Foundry Trade Journal*, 165, Strand, London.

FOR SALE AND WANTED.

LYCOPODIUM 500 kilogrammes (1,100 lbs.) offered FOR SALE by Swedish exporters. Reply in the first instance to A.M.H. (B/580/16), c/o Swedish Chamber of Commerce, 5, Lloyd's Avenue, London, E.C.

FOR SALE.—24-in. Invincible Sand Mixer, capacity 3 tons per hour, for grinding, mixing and screening foundry sands, at lowest cost per ton.—Apply, HALL, 26, Paradise Square, Sheffield.

SILICA in plastic form, stones, sand, &c., for furnaces and cupola linings.—Apply, PONSFORD, Newport, Mon.

FOR SALE, 2 Single Wheel Floor Grinders, by Rowlands, Admit Emery Wheels, 30in. dia., practically new.—May be inspected at BURYS & COMPANY'S, Philadelphia Works, Sheffield.

CASE-HARDENING FURNACE, for coke fuel, with compartment, 9½in. by 12in. by 28in., size overall 3ft. 10in. by 2ft. 4in. by 2ft. 9in.; makers, Manchester Furnaces.—WIDDOWSON'S, Canal Street, Nottingham.

SIZE "N" ACME BLOWER, ROOTS' TYPE, No. 3,827, 20in. outlet at bottom, direct coupled to Vertical Tandem Compound Engine, by Samuelson & Company, Limited, Banbury, all self-contained, on massive cast-iron box, section bed-plate with barring gear, air valve, all complete and new, designed for a capacity of 9,000 cubic feet of air per min. at a pressure of 20 ounces W.G.—Apply, ROBSON, Machinery Merchant, Port Talbot.

COMPLETE TROPENAS STEEL PLANT FOR SALE.

COMPLETE TROPENAS STEEL PRODUCING PLANT, consisting of Cupola capable of melting 10 tons per hour, with Waygood Electric Hoist, Staging, and steam-driven Roots Blower; 2 2-ton Converters with electric tilting gear, and very fine Steam Twin Cylinder Air-blowing Engine; Lancashire Boiler, by Galloway, Limited, Manchester, 30 ft. by 8 ft., 160 lbs. working pressure, with Gauges, Pipes and Mountings; also 4 3-ton and 2 9-ton Lip Pouring Ladles. The plant is now in operation, and is offered for delivery in, approximately, six months. It is capable of producing 25 tons of steel per 10-hour day, and is suitable for making castings up to 10 tons in weight.—For further particulars, apply to No. 596, Offices of *Foundry Trade Journal*, 165, Strand, W.C.

PATTERN SHOP SUPPLIES.

Wires: "Requisites, B'ham." **J. BURN & CO.,** 'Phone: 137 Victoria

Henshaw Road, Small Heath, BIRMINGHAM.

Is it a question of scrapping that faulty casting or risking a dissatisfied Customer?

You can avoid having to make decisions of that sort by installing a system of light which is highly penetrative without glare, and which will enable the workman to detect the smallest blemish in the sand before pouring off. . .

Write to us or full details and information.

The Westinghouse Cooper Hewitt Co., Ltd., Specialists in Factory and Works Illumination, 80, York Road, Kings Cross, N.

ARE YOU INTERESTED IN THE PRODUCTION OF CHEAP, ACCURATE CASTINGS?

We Specialise in :: MOULDING MACHINES, PATTERN PLATES, MOULDING BOXES, SNAP FLASKS, etc. :: :

ADAPTABLE MOULDING MACHINE CO., Stanhope St., BIRMINGHAM

Telegrams: "ADAPTABLE." 'Phone: 1966 Mid.

PLUMBAGO—CRUCIBLES.

Parting Powder.

William OLSEN,
Cogan Street, HULL.

FOUNDRY MATERIALS AND REQUISITES.

Largest Stock of Straw and Wood Fibre CORE ROPINGS.

Wax Core Vent.

GLUTRIN—CORE GUM.

T. E. MANSERGH.

EVERY DESCRIPTION OF
MOULDERS'
PATENT WOOD, MINERAL AND
COAL DUST BLACKINGS
MANUFACTURED.

Wheathill Charcoal Works, **SALFORD.**

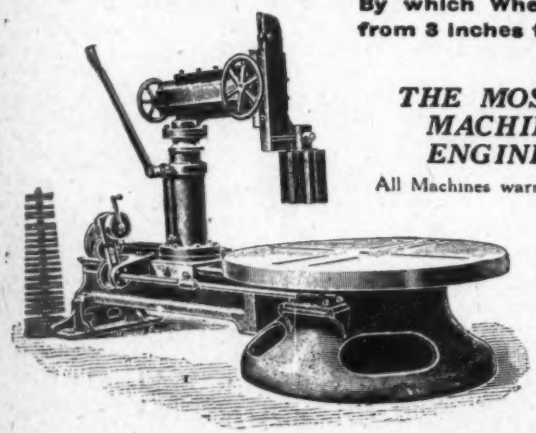
38½
McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application to
CHAS. McNEIL.
KINNING PARK IRONWORKS,
GLASGOW
38"
32½"

CAN ALSO BE MADE IN ALUMINIUM.

Kindly mention this paper when enquiring or ordering.

WHITTAKER'S IMPROVED MOULDING MACHINE

By which Wheels or Pulleys of any description or size from 3 inches to upwards of 20 ft. diameter can be made.



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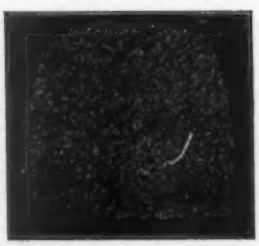
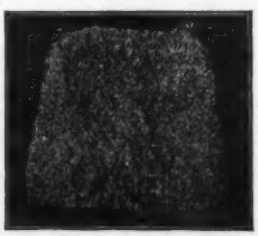
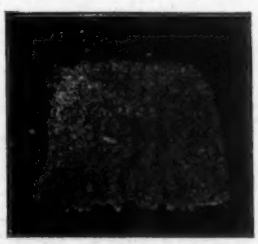

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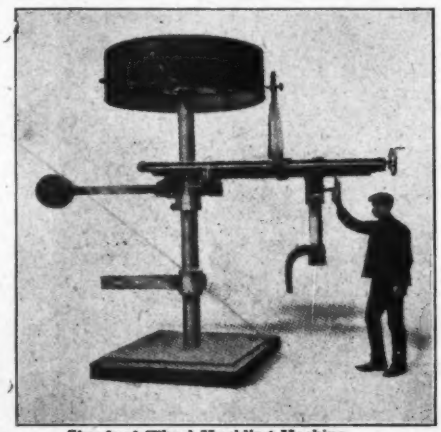

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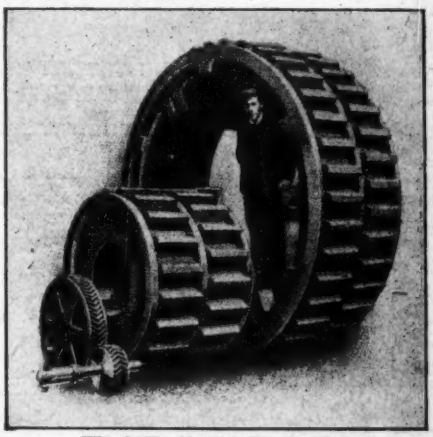

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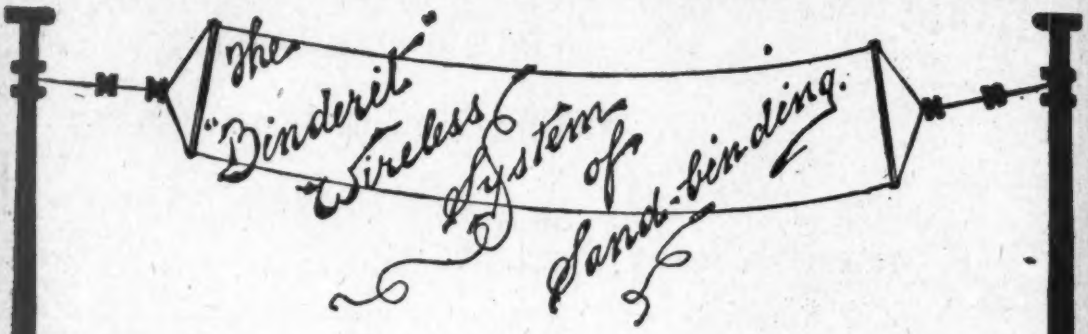

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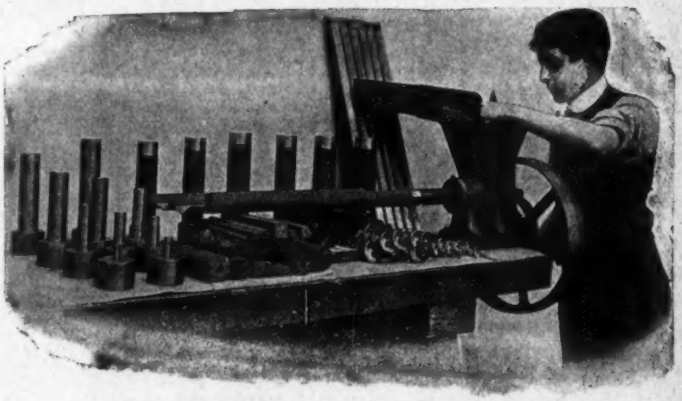

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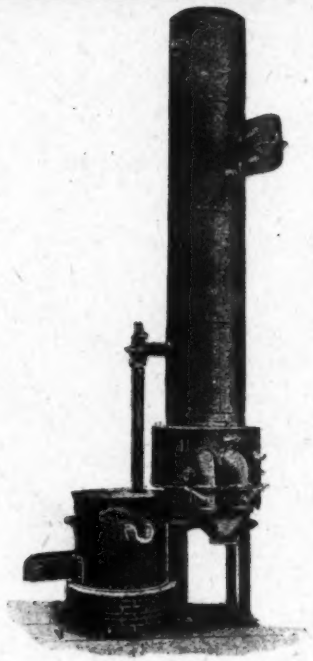

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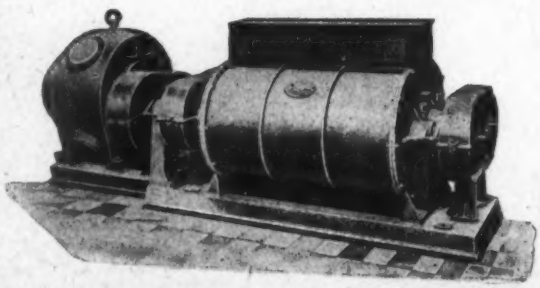

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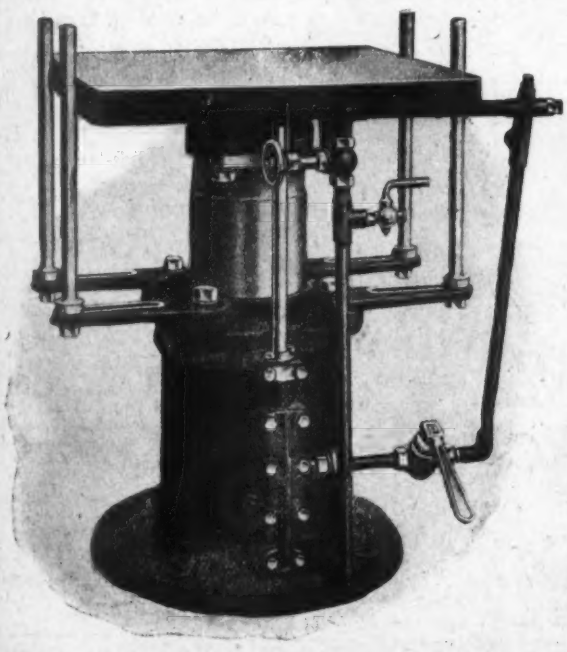

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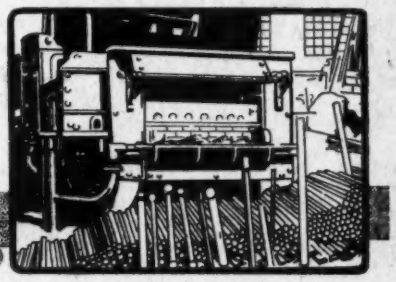

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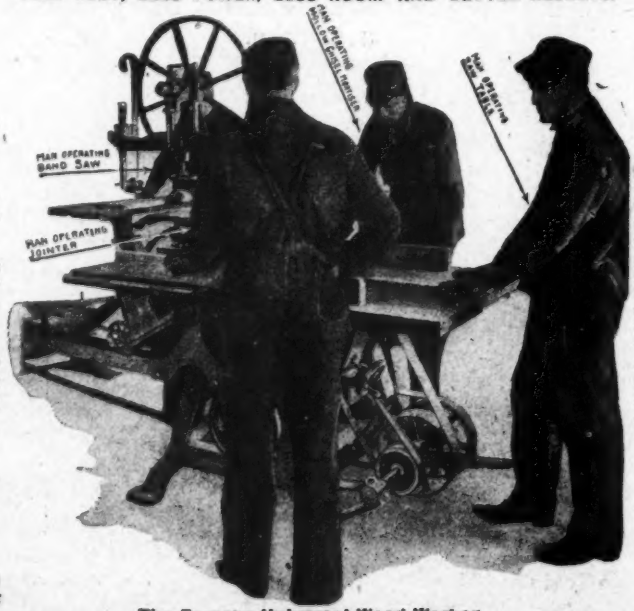

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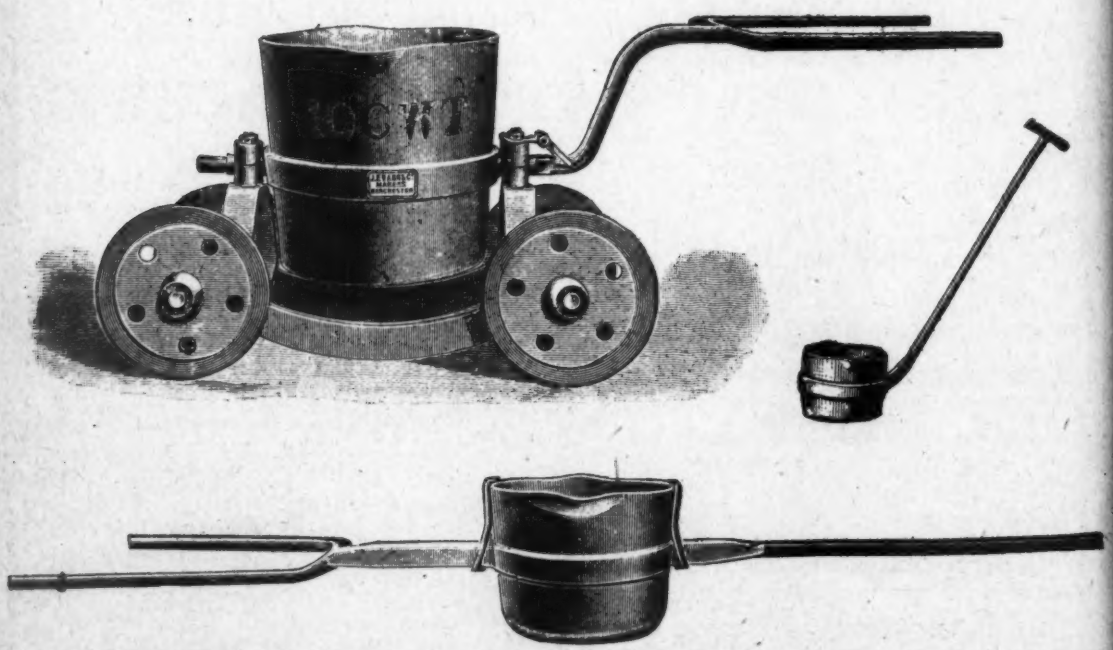

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